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VOL. 9 No. 5 Published Monthly MAY 1960

hot news

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Incidental information

No.13

Items of interest from our laboratory notebooks

Most analysts know about 1:10-phenanthroline and many use it for iron determinations. Not so many people seem to know that **4:7-diphenyl-1:10-phenanthroline** is twice as sensitive as 1:10-phenanthroline in the colorimetric determination of iron. There are several papers on the subject but the latest is *Analyst*, 1958, **83**, 80. The reagent is also called **Bathophenanthroline**, and we make it.

Then again, the substitution of methyl groups in the 2:9 positions has the interesting effect of making the reagent insensitive to iron and we then have a selective and sensitive reagent for copper (see *Anal. Chem.*, 1956, **28**, 1158). Hopkin & Williams make **2:9-dimethyl-1:10-phenanthroline** (sometimes called **Neo-cuproin**).

One does not think of sulphate as a radical one can determine absorptiometrically, but this is now possible for low concentrations. **Barium chloranilate** is the reagent and there are two papers on the subject — *Anal. Chem.*, 1957, **29**, 281 and *Anal. Chem.*, 1958, **30**, 202. Hopkin & Williams make it.

Hopkin & Williams Ltd. were also early off the mark with supplies of the remarkable new colour-producing reagent for fluoride ions, **3-aminomethylalizarin-NN-diacetic acid**, described by Belcher, Leonard and West (*Talanta*, 1959, **2**, 92). This important reagent is already available from stock.

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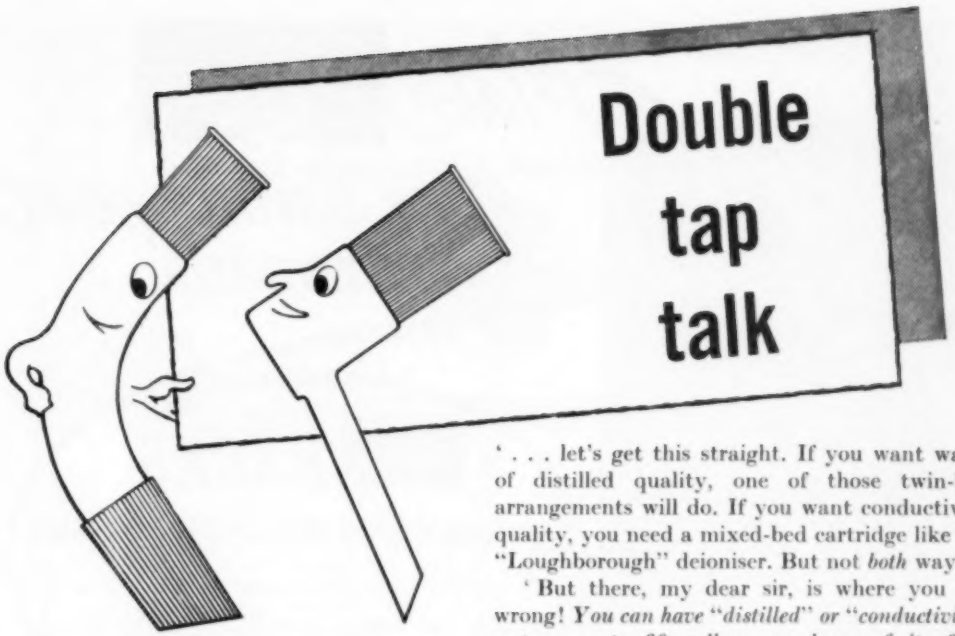


'. . . let's get this straight. If you want water of distilled quality, one of those twin-bed arrangements will do. If you want conductivity quality, you need a mixed-bed cartridge like the "Loughborough" deioniser. But not *both* ways.'

'But there, my dear sir, is where you are wrong! *You can have "distilled" or "conductivity" water—up to 30 gallons an hour of it—from Loughborough's new Stonwata A.300 deioniser.*'

'Now, just a minute! "Distilled" or "conductivity" water out of the same tap? That's stretching it a bit far, isn't it?'

'Not a bit. The A.300 is really two units in one. The multi-bed unit produces "distilled" water. You can either use it as it is, or pass it through the mixed-bed cartridge to step it up to "conductivity" level — all at the turn of a tap.'

'Mm! Sounds feasible — but I shudder to think of the regeneration problems.'

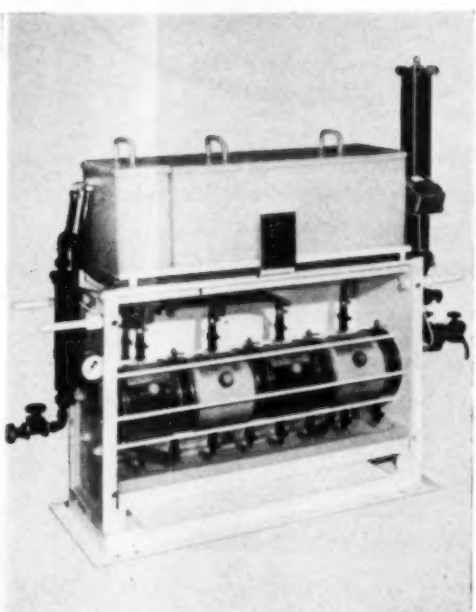
'Not with this one. The clever way the multi-bed unit's been designed makes that very simple — you just fill up the built-in tanks with regenerants, open the valves, and in an hour it is *ready to yield another 300 to 2,000 gallons*, according to your water supply.'

'And the cartridge . . . ?'

'Oh! That goes back to Loughborough, but since it has "distilled" water fed to it, you only need to do this every 1,000 gallons or so.'

'*300-2,000 gallons, eh?* I'm going to find out more about this.'

'Well, you only have to drop a line to . . .



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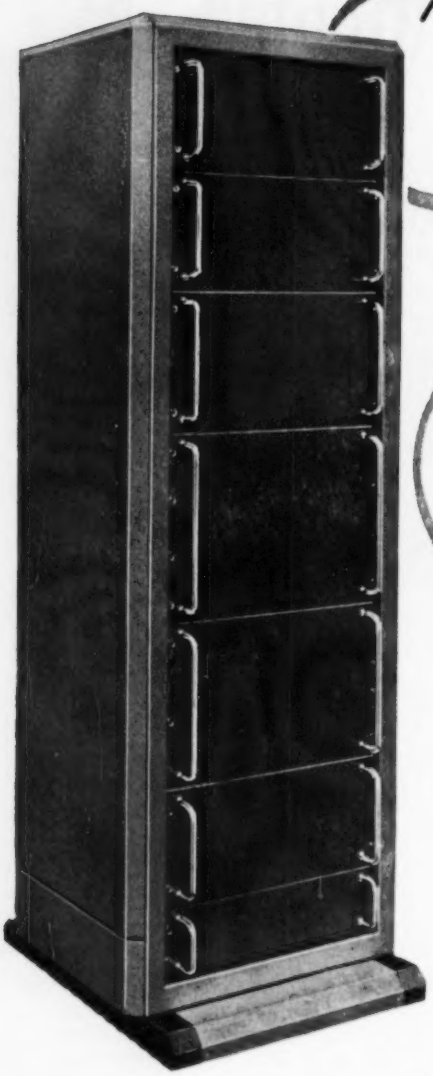

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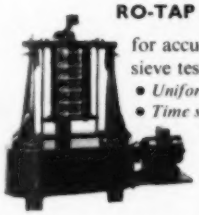

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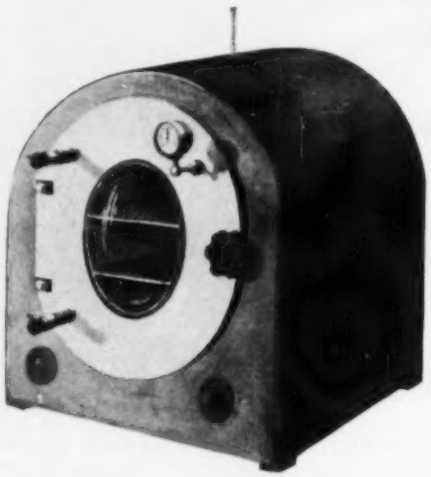

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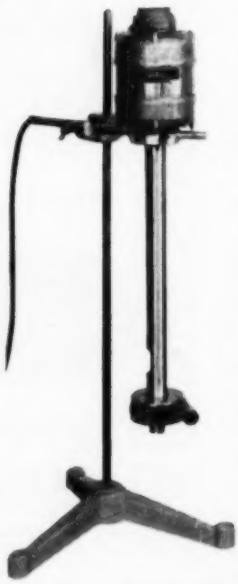

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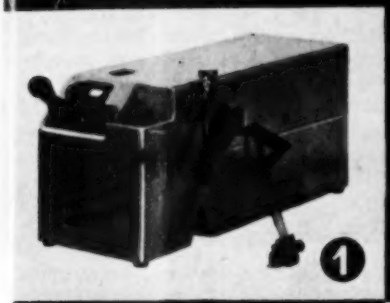

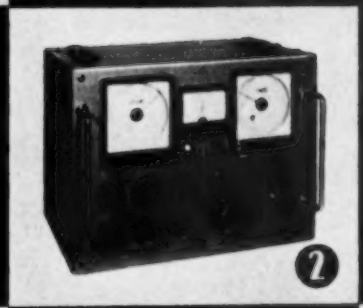

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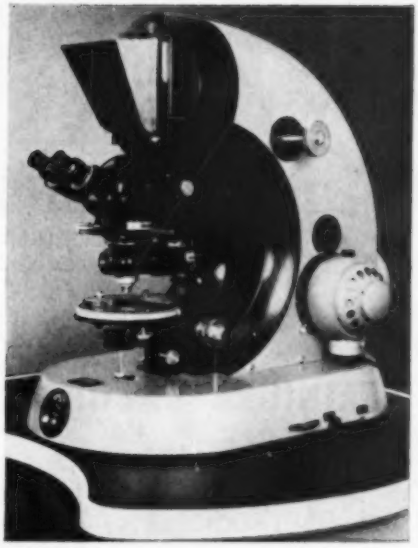

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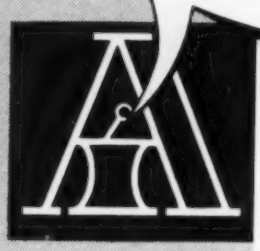

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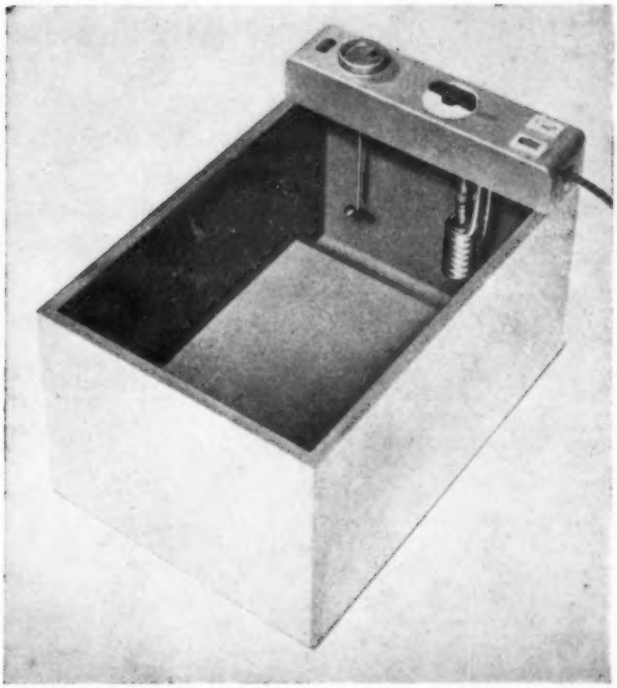

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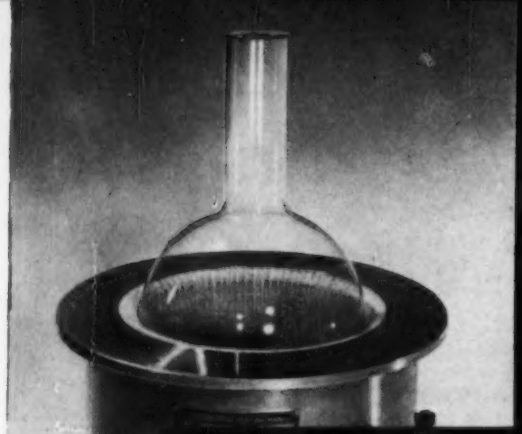

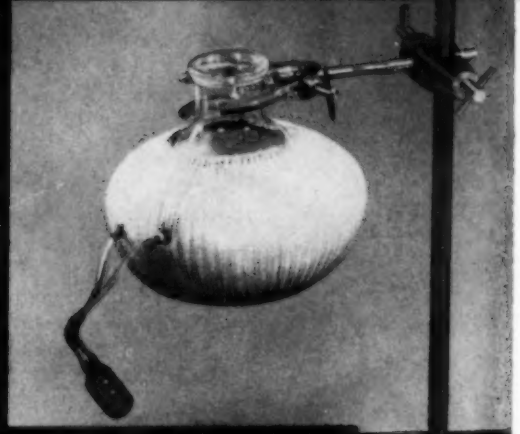

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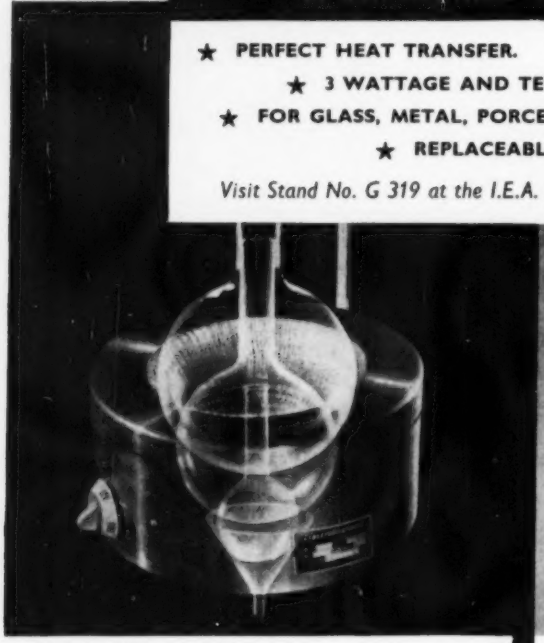

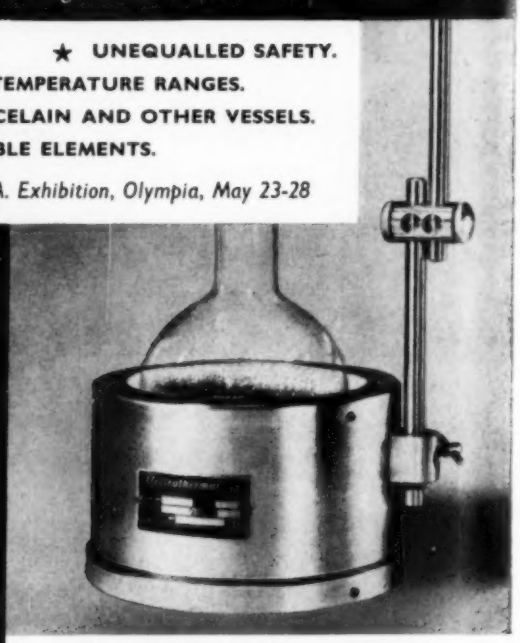

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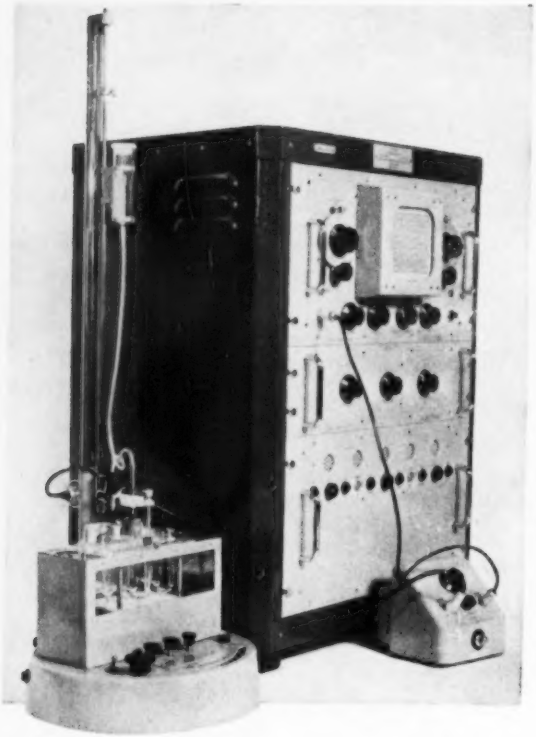

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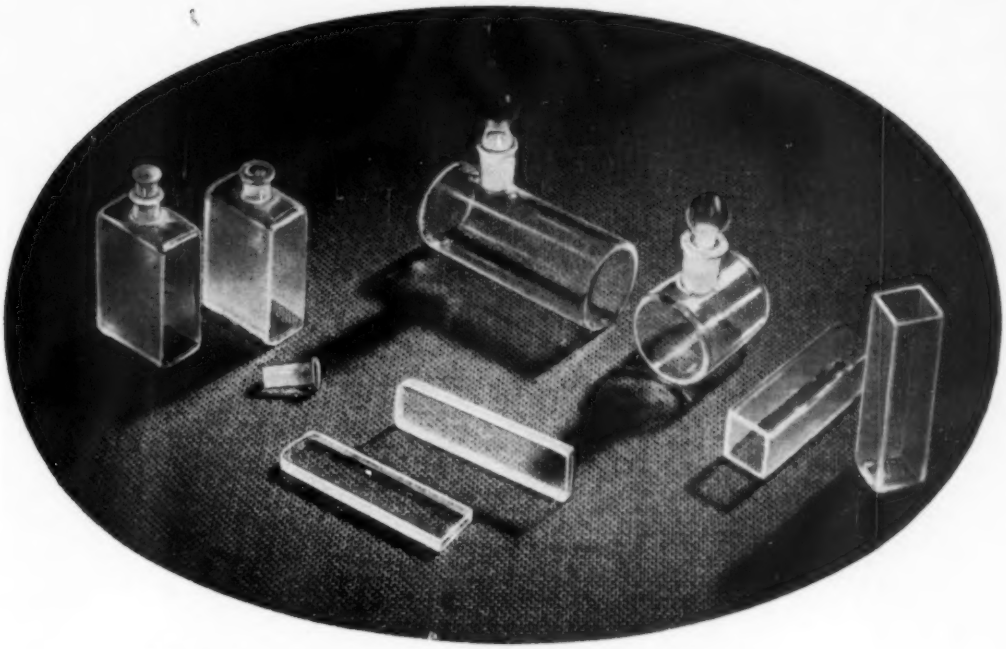

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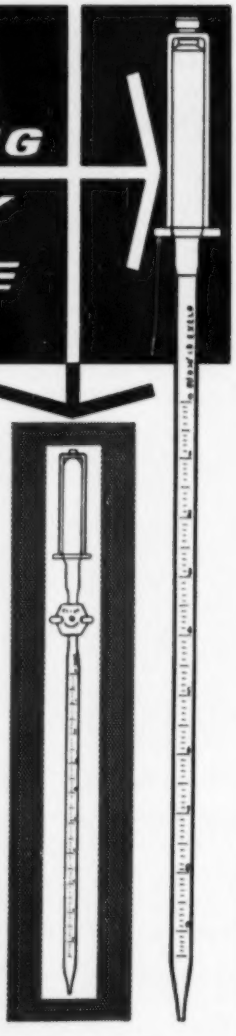

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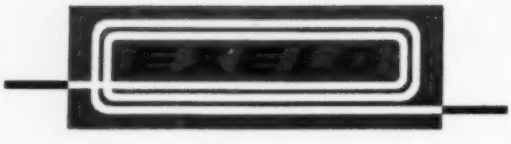

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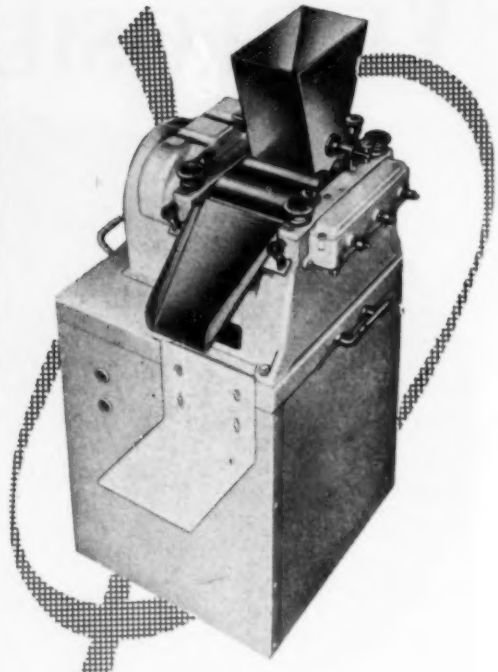

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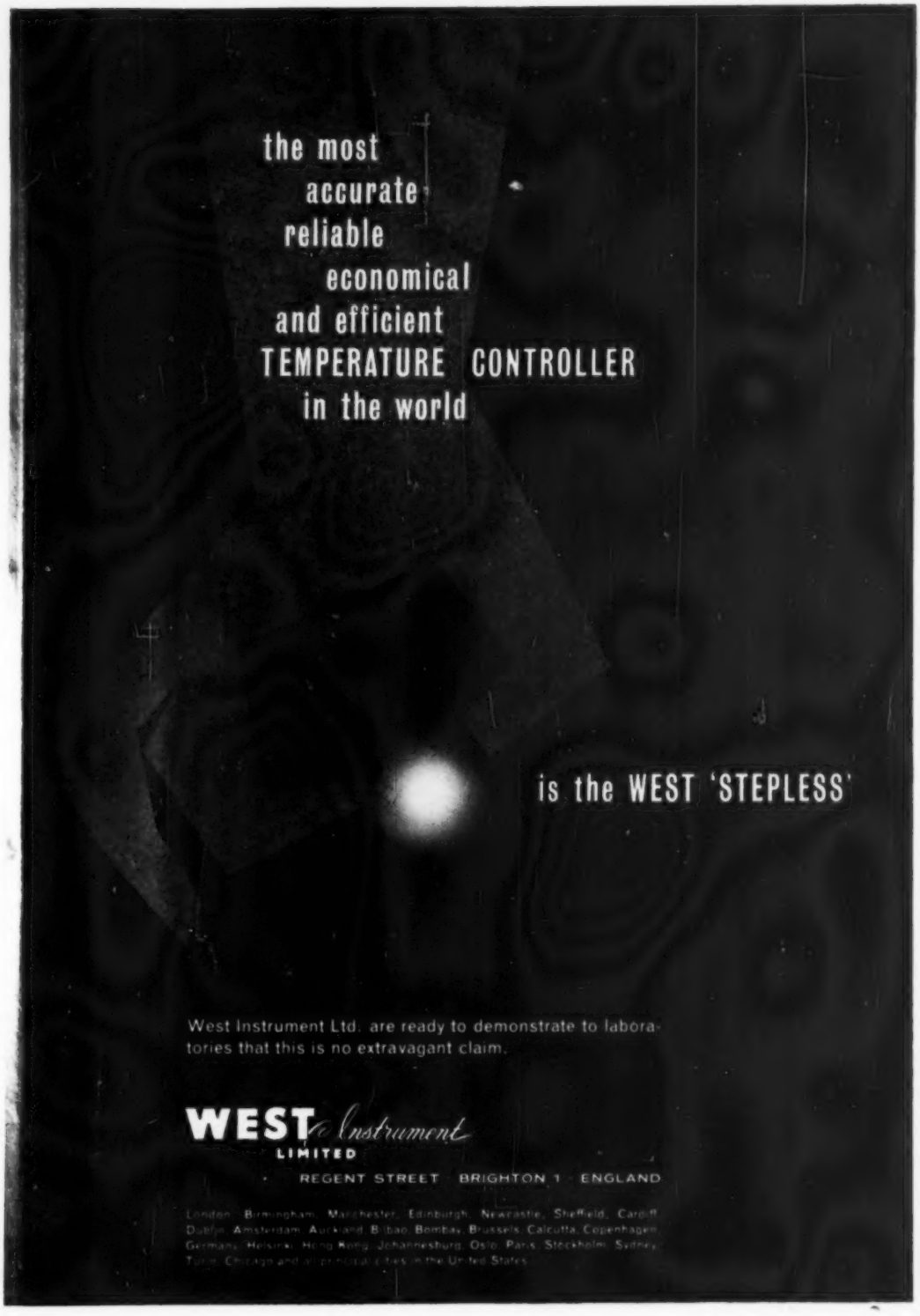
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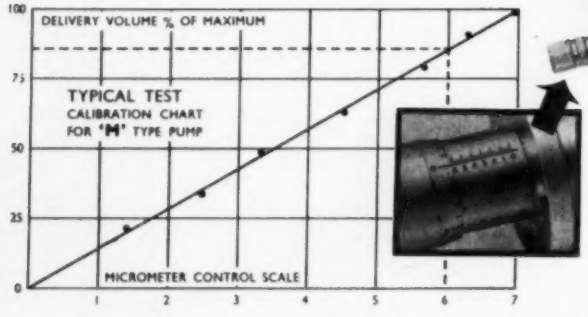

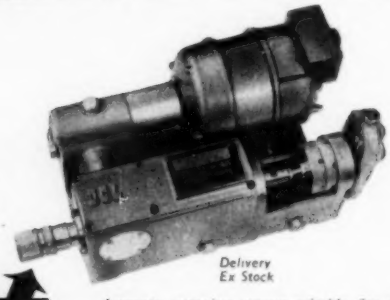

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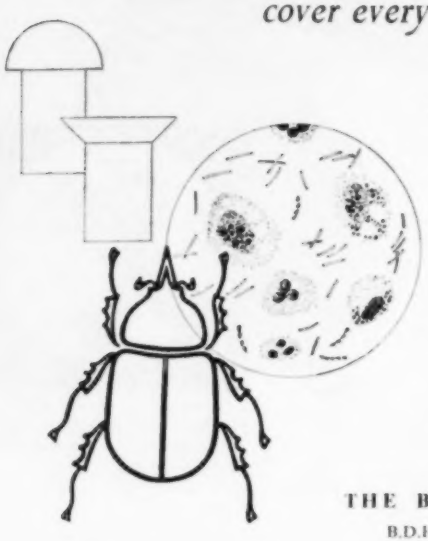

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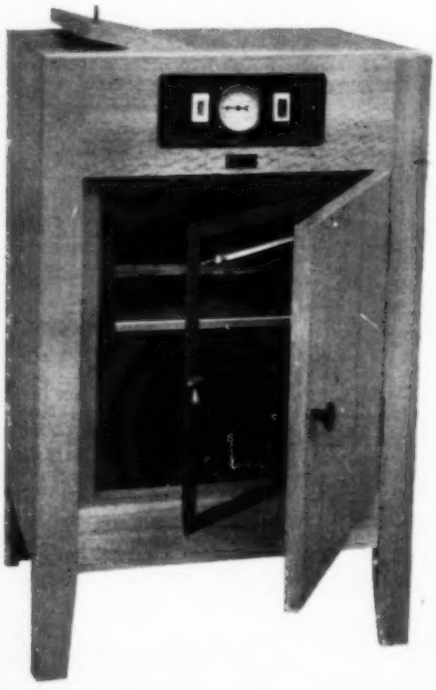

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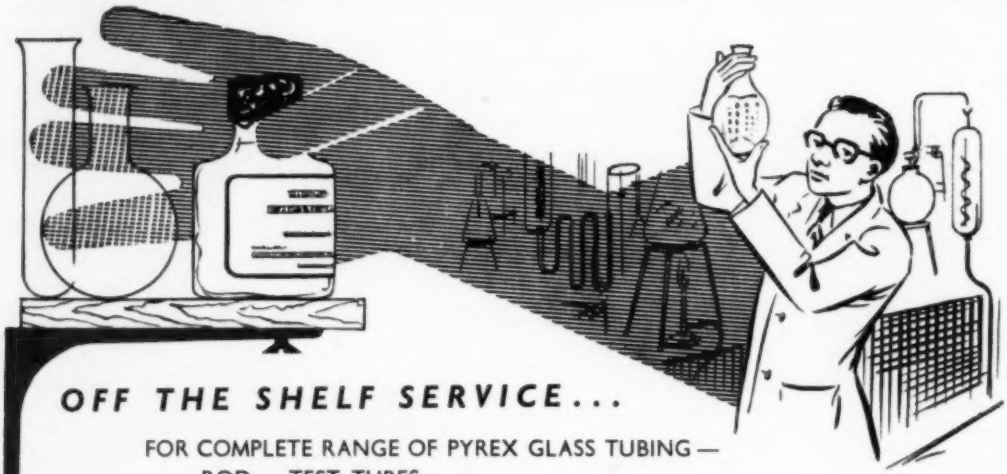

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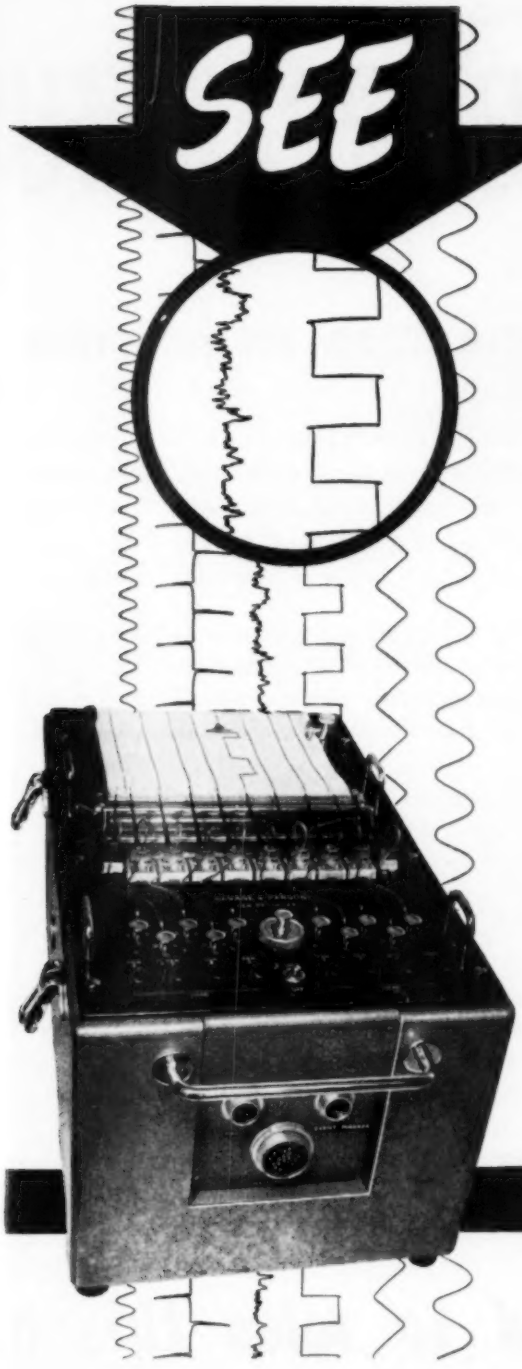

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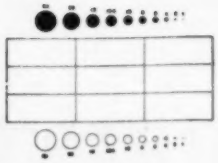
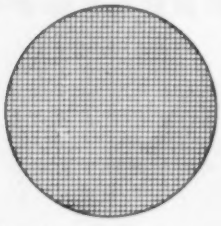
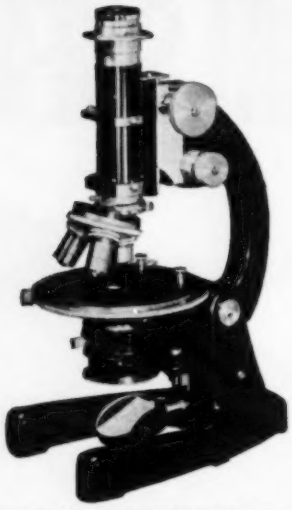
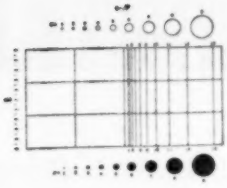
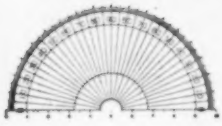
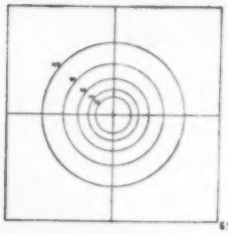

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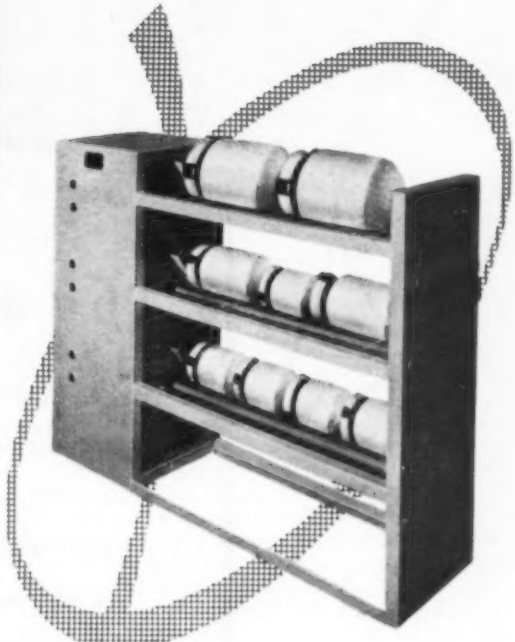

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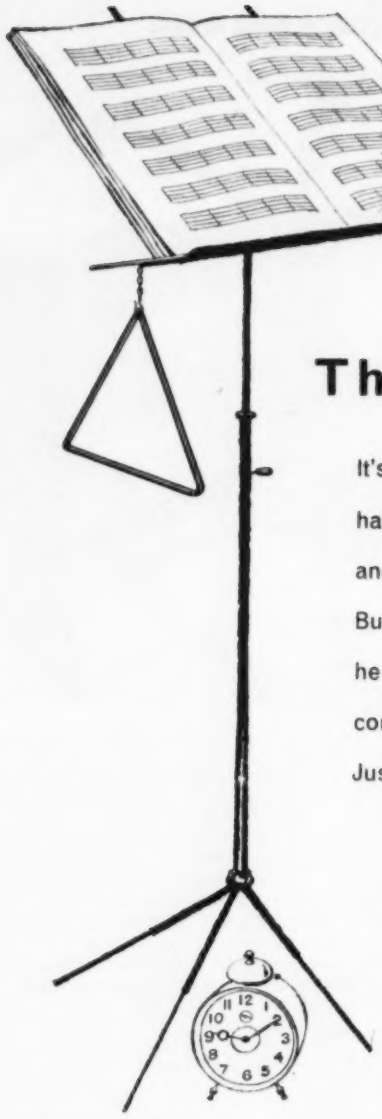
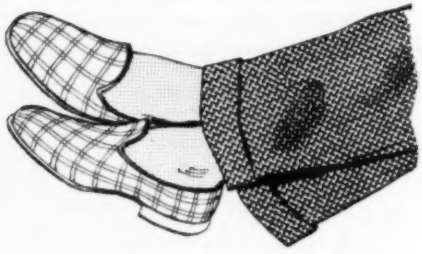


The other man's job—

It's almost money for jam—
half an hour of the symphony gone
and he hasn't played a note.
But, when the right moment comes
he will make his
contribution with precision.
Just as we do.



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EDITORIAL

Progress

IN these days of continued high taxation—about a quarter of our incomes go to the Government—it is worth considering whether we are getting value for money. Few will cavil at the money spent on education, pensions and medical services, but many feel uneasy about the fate of much of the money spent on technological research. Whether the head-lines of the popular newspapers are an accurate reflection of matters as they really are must be a matter of opinion. The main topics in this field seem to be missiles which won't missile, rockets which won't rocket, and vague, inaccurate and often absurd talk about space travel. While knowledge is always worthy for its own sake, and one never knows when an academic observation may lead to a new industry, the balance between our efforts in various fields and the purpose behind these efforts are problems which should be constantly kept in mind. We have never been very clear as to what, in space travel, really justifies the enormous expenditure on it. If it is to get away from a planet where the inhabitants have so far failed to organize their living on a rational basis and to utilize properly the gifts of Nature, then there is certainly a strong case for exploring space. However, as human beings will still be involved, there is no guarantee that any new worlds will be better run—they may be brave but not necessarily more intelligent than the old one.

As a slight off-set to this rather depressing outlook, it is a pleasure to announce a major progress in a practical aspect of life. The gentlemen who design and build our houses are beginning to discover the elementary laws of heat, and the methods of heating our houses and buildings are being revolutionized. Fortunes are being spent in advertising new equipment for this purpose, and most ingenious new ways are being used in colleges and public buildings. One recently fashionable method is to instal heaters on the ceilings, thereby producing those hot heads and cold feet so appropriate to a university examination room.

Visitors to our country from the Continent have for long been puzzled by the cleverness with which our houses make the most inefficient use of heating systems, breaking all the known laws of heat in such a crude

way that it would shock a fourth form school-girl if she really thought about it instead of spending her science periods learning formulae by heart. After prolonged research into this fascinating question, with its scientific and social implications, we are able to shed some light on the story behind the scenes.

Over a hundred years ago an organization not unconnected with the building trade offered a prize of 500 guineas (a lot of money in the days when a guinea was worth something) for the best designed house from the point of view of heating. This followed a particularly severe winter which brought home to all house-dwellers the importance of efficient domestic heating. At that time there was at the University of Camford a brilliant undergraduate physicist (only they called them natural philosophers in those days) who thought he would enter the competition. It was not that he wanted the money—far from it, for he was the son of a wealthy father, like most undergraduates of those days. His interest in the competition was for amusement only, and as an intellectual exercise, the examinations in those days being necessarily tied down to the level of the examiners, he set out to design a house in which all the laws of heat conservation would be broken and as many stupidities introduced as possible. He started by doing the obvious things—the boiler in the hottest part of the house so that one room would be unbearably hot, all chimneys on the outside walls so that as much heat as possible would be dissipated, and so on. Naturally, particular care was taken to reduce insulation to the minimum. By giving very easy access of the outside air to under the floor boards, these could easily be maintained near the freezing point in cold winters. Boards always warp after a few years, and the whistling of the wind through the cracks on a windy day is a familiar sound to us. With a gale some very impressive effects can be obtained, such as the lifting of the carpet, an external manifestation of a clever internal arrangement. By such thoughtful devices as these he committed generations of British people to sitting in front of the drawing room (before lounges were thought of) fire with roasting fronts and freezing other parts. Naturally all walls were completely devoid of insulating material or construction.

Upstairs the designer was equally imaginative. A child, with no knowledge of the subject, would put the hot tank in the bath room, where it would serve many useful purposes, and wrap some insulating material round it. Thus one would conserve the heat in the water, be able to air clothes in the linen cupboard above the tank, be able to dress if necessary in a room warm at all times, bath in a warm room, and so on. Our natural philosopher soon put a stop to such a simple and straightforward scheme. By placing the hot tank, uninsulated, on the landing against the outside wall, it was possible to have a system whereby with only the greatest difficulty was it possible to get a really hot water supply. Naturally there was no insulation on the ceiling, and the roofing methods not only failed to use the space underneath but kept the ceilings, like the floors, well down in temperature in cold weather.

All water pipes were kept as near as possible to outside walls and the coldest parts of the house. It is not surprising that burst water pipes have been a prominent feature of domestic bliss in cold winters, and this is where the young man rose to unexcelled heights of brilliance. An ordinary person would put the main water cock just inside the back door or some other place where it could conveniently be reached quickly in an emergency. Nothing so obvious was acceptable to our competitor. He not only chose the most inaccessible spot in the garden, usually hidden amongst bushes, but had the cock buried in the ground. A drain-pipe was used to give access so that, assuming it had been found on a dark night, a man with a very long arm might just be able to reach the cock after clearing away the dead leaves, snails and stones.

Having completed this masterpiece the young natural philosopher sent it off and waited with interest, wondering what sort of sarcastic letter he would get from the adjudicating committee, or whether they would just ignore it. Nothing happened for some time, and the young man had almost forgotten the incident, having turned his attention to other pursuits popular at the University at that time, when one day he received a letter telling him that he had been awarded the prize and enclosing a cheque. Stunned by such a communication, he waited for a further letter advising a clerical error. None came, except one three months later stating that the organization awarding the prize was so pleased with the design that henceforward all British houses would be built on this pattern.

So this was how things were—and remained until recently. Whether there really *was* a clerical error, or whether the judges were associated with the coal industry, will now never be known. By such a trifling thing can the destiny of a great industry be shaped.

Now that science is being brought into play in domestic heating there seems to be endless possibilities —utilization of simple methods of insulation, recognition of the fact that hot air rises, the use of hot air for heat distribution, an efficiency of nearly 95 per cent instead of nearly 5 per cent in utilization, the production of heat where it is wanted, and so on. In time we may even have hot air circulating under our insulated floors, a method used successfully by the Romans in this country 2,000 years ago.

Open Days at the National Engineering Laboratory

The National Engineering Laboratory is to hold Open Days on Wednesday and Thursday, June 15 and 16, 1960, when the laboratory will be open for inspection. Special displays have been arranged including many items developed since the last Open Days in 1958.

Representatives of any organization with engineering interests will be welcome. Applications for invitations, stating which day is preferred, should be sent to: The Director, National Engineering Laboratory, East Kilbride, Glasgow.

COMPLEXOMETRIC ANALYSIS

by J. A. R. Genge, M.Sc., A.R.I.C.

*Battersea College of Technology, London, S.W.*11

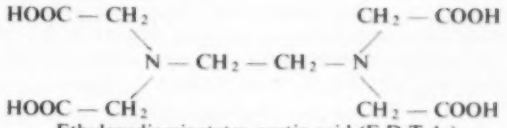
PART I—THEORY AND SCOPE

COMPLEXOMETRIC analysis or the titration of metal ions with a complexing agent is a subject of comparatively recent origin dating back some 15 years to 1945. It achieved prominence when, some years later, it was shown that the method could be used for a very elegant determination of water hardness giving separate and accurate values for the calcium and magnesium contents. Since then a very large number of papers have been published describing the analysis of most metals and a number of anions. The technique is particularly suitable for the determination of metals at low concentrations (about M/100) and, in most cases, requires only inexpensive titration equipment. Many metal determinations which otherwise would require a tedious gravimetric procedure can be simplified to a simple volumetric analysis. The method is not perfect, of course, and it is hoped in this article to give a brief survey of the theory and practice and also to give some idea of the scope and limitations.

The underlying principles of complexometric analysis are, in many ways, analogous to those of acid-base titrations. In an acid-base titration, the concentration of H^+ or OH^- is altered and the change is followed by either a physical method or with a chemical indicator which changes colour at a given pH. Similarly, in a complexometric titration, the complexing reaction results in an alteration in the concentration of free metal ions and the change is followed either by some physical method or with a coloured chemical indicator which is sensitive to the metal ion. The concentration of free metal ions is expressed conveniently as a pM value analogous to pH.

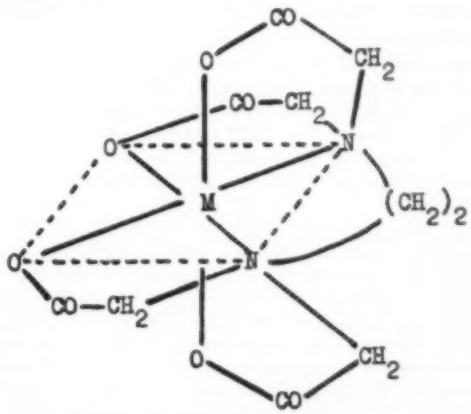
$$pM = -\log_{10}\left[M^{n+}\right]$$

If a complexing reaction of this sort is to be applicable to accurate analysis, it must fulfil the usual requirements of being rapid and stoicheiometric and giving a stable and soluble product. For the end-point to be clear, it is also necessary that the reaction takes place in one stage giving a 1:1 complex. If it takes place stepwise as, for example, in the reaction between copper and ammonia or copper and cyanide, the intermediate products have an appreciable stability and it is impossible to get a definite end-point for the reaction. It is also preferable that the complex be a chelate type with a structure involving five or six membered rings. Such rings bring about an enhanced stability in compounds of this type, a phenomenon often referred to as the 'chelate effect'. Many aminocarboxylic acids possess all of these requirements but in particular, ethylenediaminetetra-acetic acid (E.D.T.A.) has proved to be extremely useful for titrating metal ions in this way.



Ethylenediaminetetra-acetic acid (E.D.T.A.)

It forms stable and soluble 1:1 complexes with a wide range of metal ions the structures of which involve a number of five membered rings. The octahedral structure of the complexes formed between E.D.T.A. and a number of metals including the alkaline earth series is shown in the diagram. E.D.T.A. itself is not very soluble but the disodium and tetrasodium salts are both stable and soluble. The tetrasodium salt is used mainly for larger scale industrial purposes but the disodium salt is obtainable as a pure material and is quite suitable for use as a primary standard. It has two molecules of water which begin to come off at about 70°C. and the material should not be dried above this temperature.



Structure of metal—E.D.T.A. complex.

Metal ions may be titrated with E.D.T.A. either directly or indirectly by addition of an excess of standard E.D.T.A. solution followed by a back titration with a standard metal solution, usually zinc or magnesium. As many of these titrations have to be carried out under alkaline conditions, this latter indirect technique is very useful with metals which otherwise would be precipitated. In such cases the E.D.T.A. can be added to an acid solution of the metal before the pH is adjusted for the titration.

Although E.D.T.A. is ideal in many ways it lacks

specificity for any metal and a simple direct or indirect titration can only be carried out on a pure solution. Apart from the alkali metals which do not form stable E.D.T.A. complexes under these conditions, any mixture of metals in solution will give either a poor end-point or a result for the total ions present. Furthermore, the method is subject to interference from any anion which itself forms complexes with the metal. Many of these disadvantages can be overcome and the subject of complexometric analysis is devoted largely to the various techniques for achieving selectivity and analysing various ions in the presence of others.

It might be possible, although unlikely, to find a complexing agent which is specific for one metal and, at the same time, has all the other properties to make it suitable for analytical work. Variants of E.D.T.A. such as nitrilotriacetic acid and cyclohexane-tetra-acetic acid have been tried but with limited success. In such cases selectivity might be achieved by a steric effect or by an alteration in the combining power of the various ligands for different metals. Another approach, which has met with more success, is by restricting the ligands in the complexing molecule to one type. Some metals tend to form stable bonds through nitrogen ligands and others with oxygen ligands and the range of the complexing agent may be restricted by incorporating only one of these types into the molecule and not both as in E.D.T.A. Thus, triethylenetetramine and tetraethylenepentamine with nitrogen ligands only will not form stable complexes with the alkaline earth metals or with the rare earth metals.

In general, the stability of a metal-E.D.T.A. complex increases with an increase in the valency of the metal and most monovalent metals are unable to form complexes in this way. Occasionally advantage can be taken of this and it is possible to reduce a metal to a lower valency state when it will take no further part in the reaction. Also the stability of the complex tends to decrease as the pH of the solution is lowered, and while many tri- and tetravalent metals will form stable complexes under acid conditions, divalent metals usually do so under alkaline conditions only. With the right mixture of metals, advantage may be taken of this pH effect to analyse the metals separately in the presence of each other by performing two titrations at different pH values. For example, bismuth, thorium and trivalent iron can be titrated under acid conditions without interference from divalent metals. Usually the second titration under alkaline conditions gives a result for the total metal ions present and the value for the second metal is obtained by difference.

End-points have been detected in a large variety of ways including colorimetric, potentiometric, photometric and many other physical methods but the commonest and most versatile method is by the use of chemical indicators. These are analogous to chemical pH indicators and, in fact, are usually sensitive to pH as well as metals. They are coloured compounds which, at a particular pH, will form complexes of a different colour with a metal. Such complexes must, of course, be much less stable than the metal-chelate complex or it will interfere with the titration end-point. On the other hand, it must be stable enough to exist in very dilute solutions without hydrolysing. Many indicators of this sort are known and, while they are not usually specific for any one metal, they do tend to be applicable only to limited groups of metals. There are a number of unique compounds such as murexide (ammonium purpurate) but many of these indicators belong to one of two main groups, those based on phthalein (metalphthalein, pyrocatechol violet, xylenol orange, etc.) and those based on substituted azo compounds (eriochromes, PAN, APANS, etc.). Sometimes a mixture of metals may be analysed using two of these indicators. For example, calcium and magnesium in water are determined by titration with E.D.T.A. using eriochrome black indicator giving a result for the total metal present and using murexide giving a result for the calcium only. Most of the indicators are powerful dyestuffs and very small amounts are required for these titrations. Pastel shades are preferable to deep colours in the solution. Most of the indicators are water soluble but often deteriorate and solutions in organic solvents are better for storage. Another technique is to dilute the dry indicator with finely powdered salt and add a little of the mixed solids for each titration. When using indicators which are insoluble or only partially soluble in water, titrations may be carried out in a 50 per cent ethanol solution.

A very important technique is the use of masking agents. If a complexing agent can be found which is able to form very stable soluble complexes with one metal but not with others, that metal can be 'masked' and will play no part in the analysis. A large number of these masking agents have been used successfully. For this purpose, it is immaterial what type of complex is formed as long as it is suitably stable and inorganic ions such as cyanide are extremely useful. Cyanide will in fact form stable complexes with a number of metals including copper, nickel, cobalt, mercury, zinc, cadmium, silver and the platinum metals. Other inorganic masking agents include iodide, fluoride and thiocyanate and organic masking agents include triethanolamine, sodium diethyldithiocarbamate, British Anti-Lewisite (2:3 mercapto-1-propanol) and many acids. Lists of these and the applicable metals are given in the literature quoted in the bibliography. Masking agents may be used directly or indirectly, that is, added before the titration to render one metal inactive or after a total titration when one or more metals will be masked releasing an equivalent amount of E.D.T.A. which can be back titrated with a standard metal solution. An interesting extension of the masking technique is based on the fact that the cyanide complexes of zinc and cadmium are less stable than those of the other metals. If formaldehyde or chloral hydrate is added to a solution containing zinc or cadmium cyanide, the cyanide concentration is reduced by cyanhydrin formation and these two metal cyanides decompose. Thus, in a mixture containing say,

zinc and nickel, both may be masked while other metals are titrated then the zinc demasked with formaldehyde and titrated separately. The technique of masking and demasking makes it possible to carry out simultaneous determinations of many mixtures of metals in the same solution.

If none of these techniques can be applied, the analysis can be achieved often after a preliminary separation. This may involve a precipitation and filtering but may be possible in a more elegant manner making use of ion exchange or solvent extraction. Ion exchange is more often useful for separating interfering anions such as phosphate while solvent extraction may be applied to specific metals. For example, zinc may be extracted with methyl isobutyl ketone or lead with a solution of sodium diethyldithiocarbamate in chloroform or carbon tetrachloride. It follows from the preceding discussion of masking techniques that any anion present which is able to form a complex with the metal ion that is of comparable stability with the metal-E.D.T.A. complex, is likely to interfere with the analysis. For example, metals cannot be titrated generally in the presence of phosphates or organic acids and these must be separated or destroyed first.

Complexometric analysis can be applied to the analysis of anions if these can be replaced stoicheiometrically by a cation. Sulphate may be analysed by adding a known quantity of barium chloride, filtering and estimating the excess barium. Similarly, phosphate may be precipitated with excess magnesium and the excess determined after filtering. In much the same way, some monovalent metals, which do not themselves form stable E.D.T.A. complexes may be determined by replacing them with an equivalent amount of a polyvalent metal. Thus sodium may be precipitated with excess zinc uranyl acetate and the excess zinc determined with E.D.T.A.

From a practical point of view, the complexometric titration techniques are simple and require only inexpensive apparatus. End-points vary with the indicators but are usually good with pure solutions. The pH value is often critical and solutions have to be buffered but too great an excess of either buffer or masking agents is to be avoided as end-points tend to be clearer in solutions of low total ionic strength. Trace quantities of some metals interfere with end-points but this difficulty can be overcome by adding a little masking agent.

Detailed references have not been included but the bibliography given below contains references to all original work on the subject. For the same reason, lists of stability constants, indicators, masking agents and so on have been omitted. The book by F. J. Welcher includes a survey of all the applications of complexometric analysis up to about 1958. The books by G. Schwarzenbach and H. Flashka and the articles by C. N. Reilley *et al.* include theoretical discussions and give full practical details for a number of well proven examples. S. Chabarek and A. E. Martell give a fuller discussion of other organic sequestering agents.

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Royal Society Tercentenary Celebrations

A full programme of events has been scheduled to take place between July 18 to 26 to celebrate the tercentenary of the Royal Society.

In addition to the formal participants and their accompanying relatives, for whom the full programme of events has been principally devised, there will be a number of events to which others will be invited, notably the formal opening ceremony on the afternoon of July 19 which is to take place in the Royal Albert Hall. The Universities of Oxford, Cambridge and London will have special honorary degree ceremonies, when degrees will be conferred on distinguished scientists attending the celebrations.

A series of lectures will be delivered during the period of the celebrations in the Royal Institution, the Royal College of Surgeons and the Beveridge Hall of the University of London. The programme also includes visits to University, government and industrial research laboratories which are or have been associated with the work of Fellows of the Society. In addition there will be formally organized visits to the Imperial College of Science and Technology and University College in London. The National Physical Laboratory, the Royal Botanic Gardens at Kew, the National Institutes for Medical Research, for Research in Nuclear Science and for Research in Dairying, as well as the Royal Aircraft Establishment, the Atomic Energy Research Establishment, the Geological Survey and Museum, and the Radio Research Station and Road Research Laboratory are among the national research institutions to be visited. The British Museum (Natural History) and the Science Museum are arranging special visits and included in industrial research visits are those to A.E.I., at Aldermaston, the British Petroleum Research Centre, the G.E.C. Research Laboratories, the Glaxo Research Laboratories, I.C.I. Ltd. (Plastics Division), the Wellcome Research Laboratories and several research association laboratories.

Other visits will recall the historical associations of the Society and Shell International Petroleum Company are making a special film for the occasion which will be shown in the Royal Festival Hall on July 22.

The celebrations will conclude with the tercentenary banquet on July 26 when the toast of 'The Royal Society' will be proposed by the Prime Minister.

LABORATORY PRACTICE AND THE TERCENTENARY

The July issue of *Laboratory Practice* will be a special number comprising articles by members of the Journal's Scientific Advisory Committee and other Fellows of the Royal Society.

STAINED BLOOD FILMS AND DIFFERENTIAL LEUCOCYTE COUNTS

by G. W. G. Sharp

Pharmacy Department, The University, Nottingham

THE technique of differential leucocyte counting has been widely used for many years, and several modifications of preparation, staining and counting methods have been introduced. Basically the blood is spread upon some smooth glass surface, stained so that the individual leucocytes may be identified under the microscope, and the relative numbers of each type determined. From these the percentage of each type can be calculated. By reference to the total leucocyte count (enumerated in a haemocytometer) the absolute numbers of neutrophils, lymphocytes, eosinophils, basophils and monocytes can be found per unit volume (usually 1 c.mm.) of blood. Simple though this method appears at first sight there are in fact many pitfalls. In the course of this article it is hoped to point out most of the errors known to be involved. It is assumed of course that the sample used is a representative one obtained from free flowing capillary blood, or from venipuncture.

The most common type of blood smear is the one made on a plain glass microscope slide. For this a small drop of blood (the quantity is best gauged by experience) is placed on a clean grease-free slide and a second slide placed at an angle of 30—45° to the first. This is drawn back to the drop of blood until it just makes contact. After contact has been made, the blood spreads along the edge of, and behind, the slide. This slide is then pushed quickly and smoothly forward with only slight downward pressure. In this way the drop of blood is smeared over the first slide to form a blood film. The film is then dried as rapidly as possible by waving to and fro, or by blowing a mildly warm airstream over the surface. It is important to pull the spreading slide back to the drop before pushing forward because in this way the blood is pulled along behind the spreader (Fig. 1). The cells when pushed forward tend to be damaged by rupture or crushing, and naturally the larger leucocytes are the most prone to this.

In order to produce good films, the slides used must be absolutely clean, grease-free and level. The spreading slide should have sharp edges free from chips or cracks, and care must be taken not to touch the essential surfaces with the fingers thus imparting grease to the glass. Some people prefer to use cover slips as spreading slides because the width is less than the width of the slide on which the film is being prepared. This ensures that the edges of the film are on the slide surface, and cannot 'run over'. In practice, however, good films can be made in which the smear is well within the confines of the slide surface, even when a slide of equal width is used for spreading the blood. The edges are important and should be clearly visible because the larger leucocytes tend to be present in greater proportion at the edges and tail than in the body of the film. This will be discussed later in connection with the accuracy of differential counts.

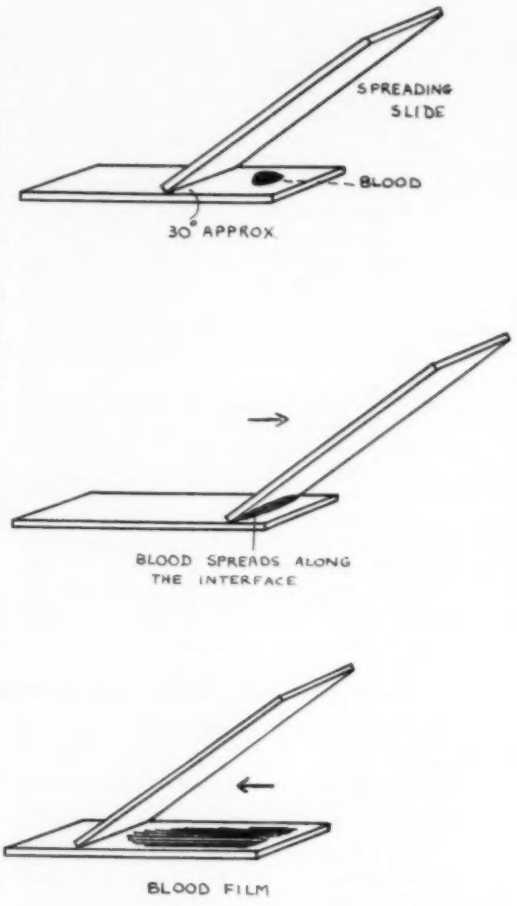

Fig. 1. The preparation of blood films on slides.

The three factors most likely to be variable, particularly until the technique has been thoroughly mastered, are the speed at which the drop is spread, the size of the drop used and the angle of contact between the two slides or the slide and spreader. That these factors are important can easily be demonstrated by spreading too quickly or too slowly, using too much or too little blood and by using extreme angles. The aim is to produce an

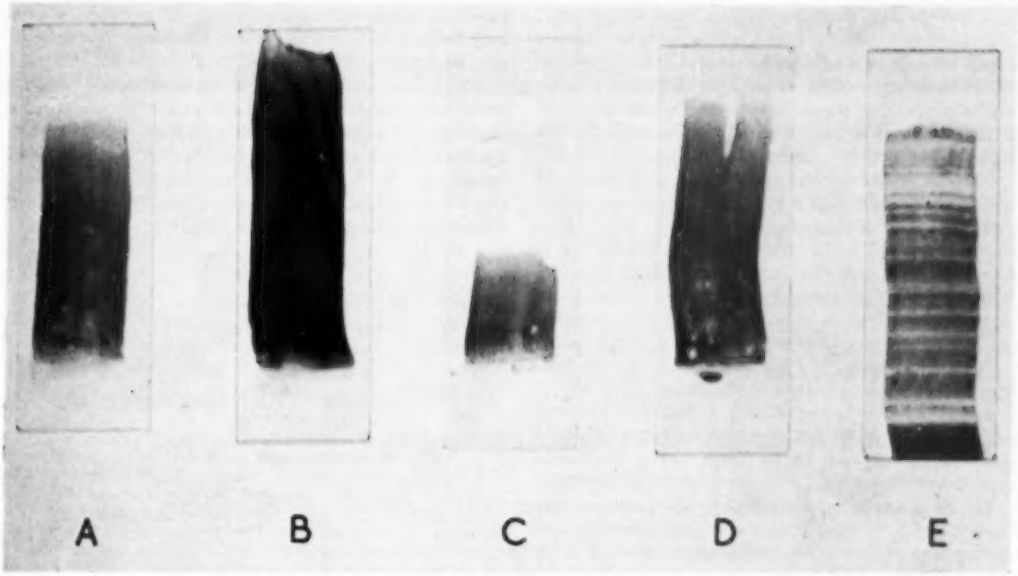

Fig. 2. Examples of some common faults in blood film preparation. A. A reasonably good film, dust on slide. B. Too much blood. C. Too little blood. D. Dirty slide used. E. Slow and jerky spreading.

undamaged and evenly distributed unicellular layer of the formed elements. Generally speaking, too rapid spreading will result in films too thick to carry out the count, while a film that has been spread too slowly will result in a very thin film. The effects are as if too much and too little blood has been used respectively. The pressure used should be slight and the angle constant throughout. Silberstein (1940) has recommended an angle of 30° for reliable distribution of cells, but it depends upon the individual rather than upon a fixed angle. Some examples of smears prepared with a faulty technique are shown in Fig. 2. One of the most common faults during first attempts is to spread the blood with a jerky movement giving a series of thick and thin layers across the film. This is in contrast to the effect of an uneven or chipped spreader which gives a thick line along the length of the film. Rapid drying is also important because the osmotic pressure of the plasma increases as the water evaporates off. A prolonged drying process causes distortion of the cells due to crenation in the hypertonic plasma. This can easily be demonstrated by preparing the film in a cold atmosphere and observing the consequence of slow drying directly under the microscope.

Once the film has been prepared and dried it must not be touched until after fixation. The fixing process is commonly part of the staining method. Romanovsky type stains such as Leishman's are very often used and the following method has been found to give consistently good results. The slides, usually in batches, are placed in a staining jar and immersed for one minute in Leishman's stain. A little over half of the stain is poured off (often into the next slide batch) and the jar filled by the addition of distilled water buffered to pH 6·8. The jar is agitated gently for a time of five to ten minutes depending upon the strength (more correctly the staining ability) of the particular stain in use, and then washed with water for about a minute. The appearance of the film is one of the best guides for washing time, the initial blue tinge changing to a distinct pinkish hue when sufficiently washed. Insufficient washing will result in an over blue preparation and too much washing will cause 'fading'. A well stained preparation shows distinct and easily identifiable leucocytes with eosinophilic granules stained a brickish-red or pink colour, in strong contrast to the basophils with their deep blue, almost black, granules.

Even when the film is well prepared, variations in the distribution of the leucocytes occur. This is one of the sources of error which is most difficult to overcome and has been mentioned by the author in a previous article. The tendency is for large leucocytes to be carried along to the sides and tail of the film in larger numbers than the small leucocytes. This leaves a relative lymphocytosis in the main body of the film. For this reason alone, many different ways of making the film have been suggested in addition to many different ways of performing the count. Where films have long 'tongues' at the tail, the preparation should be discarded. This 'technical' error has been reduced by the use of mechanical spreaders which are capable of spreading more uniform smears, and by standardizing the counting procedures. On these lines it has been suggested that a battlement count performed along the edges of a film

would include the disproportionate edge (large cells) and body (small cells) in equal proportions so that an accurate final result would be obtained. Certainly several workers have achieved excellent results by this means, while others, taking strips running the whole length of the film have been equally successful. Theoretically, the most accurate method is to identify and count every cell on the film. Immediately, however, the prospect of counting thousands of cells becomes both daunting and unnecessarily tedious unless a sufficiently small drop of blood is placed on the slide. With such a drop it is not possible to make satisfactory blood films easily or consistently using conventional methods. It is possible to approach nearer to this ideal using the coverslip rather than the slide method. These are prepared by placing a small drop of blood on to a coverslip held horizontally by one corner, and placing a second slip on the drop, in effect sandwiching it between the two surfaces. The blood spreads between the two and after a few moments they are drawn apart with a horizontal sliding movement. Again the two films produced must be rapidly dried. It is believed that coverslip preparations are generally more even than slide films and there is less tendency for the larger cells to accumulate along the edges. Until this error is completely eliminated large numbers of cells will have to be counted for accurate results. With this in mind, mechanical spreaders have been designed, and Marks *et al.* (1950) have made a machine capable of uniform smear production which reduces the number of cells required for a count for comparable accuracy. They found closely similar results when 100 cell counts and 300 cell counts were performed, and it is well known that if all the technical errors can be eliminated only the error of random sampling remains. The latter can be calculated for any particular count.

Essentially the more cells that are identified and counted on any one film, the greater is the accuracy of the final result. As far back as 1920, Kilgore calculated that the best possible mean error in differential counting might be expressed by

$$m = \sqrt{n.p.q.}$$

where m = the mean error
n = the number of cells counted
p = the fraction of the total which is made up of the leucocyte being considered
q = the proportion of all other types of leucocytes, i.e. $q = 1 - p$.

Barnett (1930) made 100 differential counts of 100 leucocytes each on 16 coverslip preparations from the same blood sample. When he compared the mean error for each type of cell, obtained experimentally, with the formula $m = \sqrt{n.p.q.}$ he found a very close agreement. This of course bears out the fact that a coverslip blood film approaches very close to a random distribution of the leucocytes.

It can be seen quite clearly that the more cells one counts the greater the accuracy of the method, and similarly, that a differential count will not usually give very much accurate information about the numbers of, say, basophils present. These conclusions are reflected in the gradual development of haemocytometer counts specifically designed for the enumeration of cells present in only small numbers. This is particularly noticeable in the case of eosinophils and less so for basophils and monocytes. With its limitations recognized, however, the differential leucocyte count on blood films is a very useful diagnostic and research tool.

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Recent British Standards

Pressure Steam Sterilizers

Prepared by a committee made up of the leading professional and manufacturing interests, this new British Standard (B.S. 3233:1960, price 4s.) specifies requirements for pressure steam sterilizers of horizontal cylindrical form and with diameters of 7 in. and 12 in. They are for the rapid sterilization of unwrapped instruments and utensils in hospital wards, clinics, and in medical and dental surgeries; and they operate with saturated steam at a working pressure of 32 lb./sq. in. gauge (2·25 kg./cm.^{2}) (136·0° C.) (276·6° F.). Provision is made only for equipment supplied with steam from an independent source.

With the type of load provided for, there is no need to use a vacuum since problems of steam penetration and drying should not arise; as a result there is no need to reduce the pressure (vacuum) at the beginning and the end of an operating cycle, and the operation is so simple that it can safely be controlled by hand.

'Such a sterilizer', points out the Foreword to the 10 pp. specification, 'designed for air to be removed by downward displacement, can only operate successfully if the load is so arranged as to prevent the formation of air pockets. Utensils should be positioned with their openings downwards, and instruments or apparatus with a long narrow lumen should have this lumen flushed with water before sterilization'.

B.S.3233 meets the need for a specification for satisfactory equipment, of small size and of simple and economical design. Another related standard for similar equipment that is electrically heated is being prepared for separate publication.

Test Tubes and Boiling Tubes

This new publication (B.S.3218:1960, price 3s.) specifies a range of 13 sizes of test tubes and boiling tubes suitable for general laboratory use and made of either soda lime or borosilicate glass. While in the past a much larger number of sizes has been available, some of which may continue to be supplied for special purposes, the range covered by B.S.3218 is expected to provide all those sizes required for ordinary laboratory purposes and to simplify supply and storage.

The length, external diameter and two alternative wall thicknesses have been specified for the whole range of tubes, and suitable tolerances, which are the same for both soda and borosilicate glass, are specified for each dimension. The quality and annealing of the glass and the finish of the top of the tubes are also specified.

A comprehensive table is provided in which all the specified dimensions and tolerances for both types of glass are clearly shown against each of the 13 nominal sizes.

Copies of these Standards may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

THE LABORATORY APPARATUS AND MATERIALS EXHIBITION

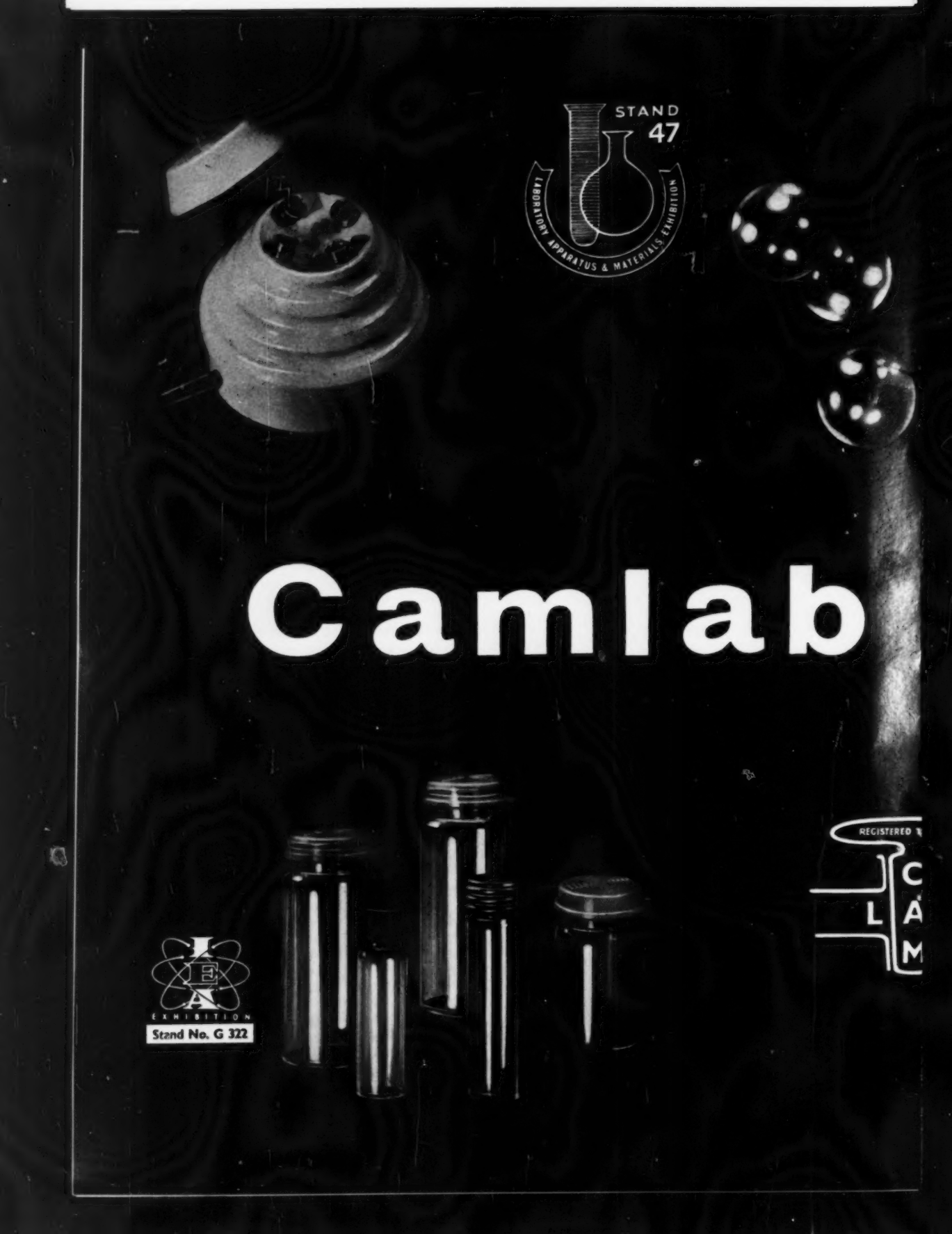
June 20 to 23, 1960

THE Laboratory Apparatus and Materials Exhibition, sponsored by this Journal and organized by U.T.P. Exhibitions Ltd., will be held at the Royal Horticultural Society's New Hall, Westminster, London, from June 20 to 23, 1960. This is the first exhibition of its kind to be organized in the United Kingdom on a national scale, where products and materials exhibited are limited to those specially produced for use in all types of laboratories. For the first time, under one roof, practically every possible laboratory requirement will be available for examination, study, comparison and selection.

In addition a comprehensive series of lectures on recent advances in laboratory techniques by specialists in their field will be given throughout the entire run of the Exhibition and the full programme is given below.

Daily glass blowing demonstrations will be given on Stand 67 by Mr. J. A. Frost of the University, Reading.

Date & Time	*Lecturer*	*Subject*	*Chairman*
June 20, 1960			
10.00 a.m.	F. P. W. Winteringham, F.R.I.C.	'The Labelled Pool Technique in Biology'	Prof. A. Wormall, D.Sc., F.R.S.
11.30 a.m.	Prof. R. Belcher, D.Sc., Ph.D., F.R.I.C.	'Indicators'	Prof. F. C. Tompkins, D.Sc., F.R.S.
3.00 p.m.	J. E. Salmon, Ph.D., B.Sc., F.R.I.C.	'Ion Exchange Techniques'	Prof. D. P. Craig, D.Sc.
June 21, 1960			
10.00 a.m.	J. Hetman, F.R.I.C.	'Polarography in the Food and Beverage Industries'	J. D. Mounfield, Ph.D., F.R.I.C.
11.30 a.m.	Prof. R. W. Douglas, D.Sc., F.Inst.P.	'Glass as a Laboratory Material'	Prof. S. Tolansky, D.Sc., F.R.S.
3.00 p.m.	G. W. Scott-Blair, M.A., D.Sc., Ph.D., F.Inst.P., F.R.I.C.	'Rheology'	Prof. G. I. Finch, M.B.E., D.Tech., F.R.S.
June 22, 1960			
10.00 a.m.	A. E. Saunders-Singer	'Micrurgy. Devices and Techniques in Biology and other Sciences'	E. Hindle, M.A., Sc.D., F.R.S.
11.30 a.m.	M. A. Fill, F.R.I.C.	'Small Scale Manipulation'	J. G. Davis, D.Sc., Ph.D., F.R.I.C.
3.00 p.m.	A. T. James, Ph.D.	'Gas Chromatography'	Prof. H. D. Kay, C.B.E., D.Sc., F.R.S.
June 23, 1960			
10.00 a.m.	A. D. Booth, D.Sc.	'Laboratory Computers'	Prof. J. D. Bernal, M.A., F.R.S.
11.30 a.m.	Prof. E. J. King, D.Sc., Ph.D., F.R.I.C.	'Clinical Biochemistry'	Sir Charles Dodds, M.V.O., M.D., D.Sc., F.R.C.P., F.R.S.
3.00 p.m.	Surgeon Commander H. M. Darlow, R.N.(Retd.), B.A., M.R.C.S., L.R.C.P.	'Safety Techniques in the Microbiological Laboratory'	Prof. A. A. Miles, C.B.E., M.D., F.R.C.P.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THEORY AND PRACTICE IN THE PHYSICAL CHEMISTRY LABORATORY

by S. Lewin, M.Sc., Ph.D.

Physical Biochemistry Research School, South-West Essex Technical College, E.17

PART VI—SOME ASPECTS OF LABORATORY ASSISTANCE AND MAINTENANCE

THE instruction of students in a chemistry laboratory, or indeed any scientific laboratory, requires efficient laboratory assistance. The type of assistance varies from that of glorified bottle-washing to that of highly skilled electronic chemical instrumentation for servicing the continually expanding number and variety of electronic instruments used for physicochemical measurements.

Reminiscing over student days one recollects the awe with which the laboratory steward was regarded. He was the sergeant-major of the students, as compared with the respected lecturer who could be considered the gentleman-officer. One could rarely get round the former, try as one would. Whether as a result of years of experience or of frustration, he would regard the student with suspicion when he returned a loaned apparatus and would examine the kit of glassware returned meticulously, perhaps hoping that he would find a breakage for which he could impose a fine. Disappointed that everything was in order he would mumble something under his breath which suggested that he was hoping to 'catch you out' the next time. Whereas the laboratory supervisor encouraged one to work after the practical period was officially over, the laboratory steward would apply King's Regulations and make quite certain that you obeyed them. The supervisor was concerned with the 'higher things' in a student's life, i.e. with the theory and practice of the elucidation of the various problems to be investigated. The laboratory steward was never concerned with such 'academic trifles'. He was determined to see that one returned *all* the apparatus one borrowed in as good a condition as that in which it was loaned (many a student felt that the laboratory steward was very sorry that he could not make the student return them in a *better* condition)—and how delighted he was to make one pay for the breakages, and in full! One respected the supervisor, but greatly feared the laboratory steward. One could be teacher's pet, but only the steward's protégé.

Looking at the laboratory steward from the supervisor's angle, the picture is no longer one of adjustment but rather one of requirement. The first approach may well be to consider a general classification of laboratory duties under the following headings:

(*a*) Duties directly concerned with student's needs.
(*b*) General laboratory care and maintenance.
(*c*) Specific servicing and repair of special instruments.
(*d*) Preparation for laboratory and lecture demonstrations.

Such a classification may be academically convenient but it does not allow for the grading and differentiation between the *levels* of laboratory duties. From the practical point of view, grading of the work is important as otherwise endless arguments concerning the salary structure are likely to be encountered. Consequently, the following graded classification of laboratory duties may be found more useful:

(A) *Duties not requiring specialized training.*

1. Issue and collection of set kits, or other apparatus, for definite experiments.
2. Cleaning and polishing benches.
3. Listing chemicals and glassware which are in short supply.
4. Maintaining and servicing pure water making units, such as water stills and demineralizing units.
5. Issuing and checking laboratory note sheets, tape-recorders and magnetic tapes used in teaching.
6. Overall inventories.
7. Preparation (by dilution only) of simple bench reagents, such as dilute HCl and dilute H_2SO_4.
8. Greasing window fume extractors.

(B) *Duties requiring an intermediate standard of laboratory training.*

1. Checking and repairing electrical gear used in the laboratory, e.g. galvanometers, ammeters, electrical and magnetic stirrers.
2. Preparation of accurately standardized solutions.
3. Checking and maintaining thermostatic controls.
4. Checking and maintaining balances in good working order.
5. Repairs of broken glass apparatus.
6. Photostating.

(C) *Duties requiring specialized training in electronic instrumentation.*

1. Checking and servicing of electronic gear, such as electronic relays, power packs, pH meters, photoelectric colorimeters, polarographs, electronic recorders and oscilloscopes.
2. Making specialized electronic circuits required in the teaching of electronic instrumentation to chemistry students.

The laboratory duties in the first category may well be carried out by youngsters of over 16 who have had no previous training but who are sufficiently intelligent to be trained rapidly in simple laboratory duties.

The second group of functions should obviously be carried out by more experienced personnel, preferably those holding a first certificate in laboratory assistance techniques, such as that covered by the Intermediate Certificate of the City and Guilds of London Institute.

The third group of duties, originally involving only a small proportion of the overall duties, is tending to become more and more important as the development of electronic gear used in the physical chemistry laboratory gathers momentum. It obviously requires a well-trained and qualified electronic chemical technician.

In general it is convenient that simple small gear should be serviced by the laboratory technician, but that specialized gear for which maintenance or servicing is offered by the manufacturers should indeed be serviced by the manufacturers' engineers. In some cases, however, it may be convenient to have the laboratory technician trained by the particular manufacturer to service a given instrument. Such a scheme does away with the need for visits by maintenance men of different firms and makes certain that rapid servicing is possible, provided that spares are readily available. However, one must balance the cost of keeping many a spare for emergency in the laboratory against the expedience of rapid maintenance. On the whole it may be cheaper to adopt a regular maintenance scheme. Experience suggests, however, that some maintenance engineers call without sufficient spares in their van. Such inefficiency is by no means uncommon and should not be tolerated. Indeed, it is surprising how once a complaint is made, all spares are readily available when a service engineer calls for the second time. It may be advantageous to buy the particular apparatus from firms who have their servicing depots nearby, but this is not always feasible.

It is sometimes possible to allow laboratory assistants in the first category, who have had several years' laboratory experience and who have attended relevant courses, to proceed gradually to undertake duties in the second category.

There is no doubt that persons holding a certificate, on the whole, are likely to know the particular group of subjects covered by the certificate to a greater extent than those who do not hold the certificate. Such a document should deserve the respect in which it is held. However, there are many qualities required in a laboratory technician or technologist which are not covered by any certificate. There are co-operation, attention to detail and determination to carry out the work, which involve a high degree of conscientiousness and of course loyalty. The last may, however, result in an unusual situation. Many stories are in circulation concerning the preparation of organic compounds which have occasionally failed. Their variations are such as to make them apocryphal. One variation concerns a laboratory assistant to a professor who eventually succeeded in synthesizing a certain compound X. When the professor felt that the method was foolproof he announced that he would explain and demonstrate the synthesis at a special international meeting. As sometimes occurs with new methods and techniques, there came a time when he was unable to reproduce the result even though he had used what he thought were the same conditions as before. Finally, the day before the meeting, he discovered the trouble-causing variable. Anxious that the demonstration should be successful he took his assistant aside before the beginning of the lecture and asked him to ensure that everything was carefully carried out, because otherwise his reputation might well suffer. 'Don't worry', said the assistant, 'Not only have I mixed everything in the right proportions, I have even added the compound to the mixture'.

In theory the qualities required in laboratory assistance and maintenance should be high. But in practice these have to be tempered on the basis of the law of supply and demand. It is obvious that the availability of good laboratory assistance and maintenance must be affected by quite a number of factors which are outside normal control. For example, the expansion of scientific and technological work in industry and other non-educational fields accompanied by comparatively high monetary rewards and sometimes even part-time day release have tended to decrease the number of potential applicants for the posts of laboratory technician and stewards. In academic institutions the result has been that candidates of calibres lower than those required have had to be appointed to such posts. Several means may be adopted in dealing with such difficult situations. One method widely adopted was to appoint students who ran short of money as temporary laboratory assistants, who continued to study in their free time until they obtained their degrees. Unfortunately some such appointees tend to regard most of the time during which they are supposed to be engaged in laboratory assistance as their free time.

It should be recognized that many people feel that a post concerned with laboratory assistance, maintenance, or whatever else it may be termed, is a dead-end job that should be avoided at all costs. But is this attitude really correct? After all, many academic posts also prove to be dead-end ones, as a great deal depends on circumstances, or luck, and on the qualities of the person concerned.

It may be recognized that academic education under certain conditions is likely to result in a higher status, accompanied often by a considerably higher financial renumeration.

It should be equally recognized that some aspirants to purely academic courses are unlikely to obtain a good academic qualification in a reasonable length of time, and that their energies are far more likely to be profitably employed in following practical courses, where there is a good chance that they will distinguish themselves.

It should also be recognized that neither an eleven-plus examination nor a General Certificate of Education Examination is the final criterion in assessing the suitability of the candidate for financial awards leading to high academic or parallel qualifications. There are quite a number of potential celebrities who can be safely placed in the category of late developers, but for whom there exists no suitable mechanism to enable them to attain full-time day academic education in financial security. Part-time day and evening classes do exist in colleges but, as anybody connected with them knows full well, the struggle to attain high qualification

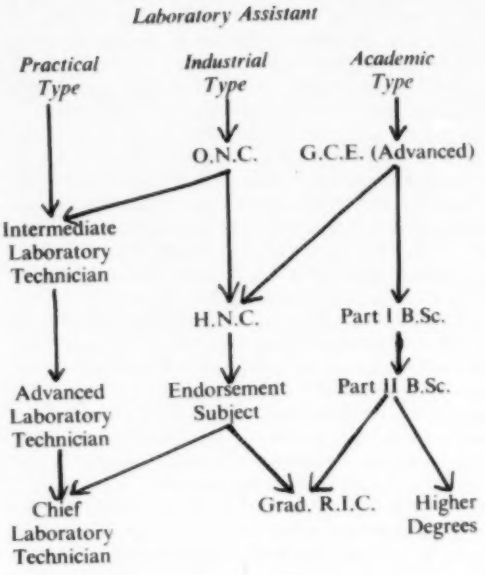
in such classes is quite exhausting, as it requires not only adjustment of the mind from the day's work to the different study problems, but also often involves transport and associated financial difficulties.

Now, success in a given field of study depends not only on the person himself, but also on the surrounding atmosphere. A person aspiring to a higher qualification, if working as a laboratory assistant, in a college which offers study facilities in the very laboratories in which he is engaged, has opportunities which in some respects are better than those offered to the average full-time day student. He is working in an academic atmosphere and is engaged in looking after apparatus and equipment which is used towards attaining the qualification he is attempting to obtain; he has around him the academic staff who will pay more attention to him than to the average student, and who will certainly try to straighten out any theoretical and practical difficulties which he may meet. In fact he is in a favoured position. If he makes use of the opportunities offered to him he is bound to attain his qualification far more readily than if he were to work elsewhere and come to study part-time.

From the standpoint of a sensible aspirant to the higher qualifications, such as the Grad. R.I.C., who is without the necessary financial means to attain the qualification in full-time study, the use of a laboratory assistantship as an educational ladder should indeed be welcome. From the standpoint of the teaching institution it is, however, essential that such a person should understand that this post imposes responsibilities which cannot be lightly treated. Provided the aspirant understands these requirements he may be given an opportunity of such employment.

Let us consider a laboratory assistant at the lowest grade. He should be encouraged and given the opportunity to become more skilled so as to attain higher qualifications and status which are associated with higher financial awards. With this aim, the laboratory assistant should officially be given time off to be trained in laboratory technician courses or other chemistry courses. It is advocated that he be released for about four hours per week to attend such courses provided that he devotes at least an equal amount of his free time for further attendance at the course. It should therefore, be clear that people having suitable ability and determination can make use of the laboratory assistantship and that it opens to them a number of possibilities. These possibilities are illustrated in the diagram.

Let us consider now, some problems in the routine laboratory assistance and maintenance and possible associated time-saving arrangements.



Issued Apparatus

The issuing of glassware, such as pipettes, burettes, conical flasks, and its collection require quite some time and lead to congestion at the start and end of the practical period and consequently many laboratories adopt the scheme of issuing kits containing specified glassware at the beginning of the term of student's work in a given laboratory. At the end of the period, usually several months, the kit is returned and the student pays for all the breakages. To ensure that the student does pay for his breakages, he is often required to pay a deposit at the beginning of the year, which is reimbursed minus any breakage repayments at the end of the year. This scheme requires that each student be allowed some cupboard space in the laboratory. This is possible when plenty of reserve apparatus is available and when the laboratory is not in use by a series of different sets of students day and evening. However, in most technical colleges several classes of students use the same laboratory in both day and evening courses. Consequently, the laboratories are forced to issue and collect all glassware and apparatus each day or each practical session. This usually results in queues of students, and extra work for the laboratory steward, who has to examine each piece before returning it to the store. Such congestion may be avoided by 'staggering', in which groups of students come up to the store at definite times. Alternatively or additionally, kits may be booked beforehand by students; the kits should then be placed on specified benches, where the particular students work, *before* the start of the practical period.

Cleaning and Polishing Benches

The cleaning and polishing of benches used to depend on 'elbowgrease' methods; however, with the advent of polishing machines and vacuum cleaners there is no excuse for the insistence on the drudgery of 'spit and polish' methods. Indeed, the time needed for bench

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APPARATUS AND DEVICES

A SMALL-CAPACITY LABORATORY HOMOGENIZER

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Introduction

Some work on the fundamental physical properties of certain oil-in-water (O/W) emulsions on the one hand, and the application of labelled fat emulsions in physiological chemistry on the other, led recently to the need for a laboratory homogenizer for processing small quantities of emulsions to a high degree of dispersion. This requirement arose mainly from the necessity to conserve expensive components of the emulsions. In addition, economy in material and effort of preparation was desirable where emulsions, though quite satisfactory for experimental purposes, were inherently unstable (coalesced), or subject to bacterial spoilage, and fresh preparations were needed frequently. The essential aim in view was the preparation of aqueous dispersions of fat particles of narrow size range and average diameter 0·5 μ or less, the total emulsion volumes being about 5 ml.

Before describing a suitable machine for this purpose, it is of interest to record that, in a search for suitable methods of homogenization, a reproduction of the high-speed micro-blender described by Went (1958) was tried. Originally designed for breaking up biological cells and tissues, it was found unsuitable for homogenizing crude O/W emulsions. Another power-driven arrangement, utilizing components normally employed in Diesel fuel injection systems, proved capable of homogenizing emulsions to a moderate extent, but at high pressures (>4,000 p.s.i.) serious leakage of material developed. It was observed, too, that it was possible for coarsening of a fine emulsion to occur when it was passed through the machine, showing that coalescence was a factor opposing the breakdown of droplets. This interesting development was finally abandoned in favour of a hand-operated piston-type design which is the subject of this paper.

The design of the machine to be described is based on that of the Q.P. laboratory emulsifier manufactured by Ormerod Engineers Ltd., of Rochdale. In the original machine the piston moves downwards in its cylinder at each 'up' stroke of the pumping handle, and draws crude emulsion from the emulsion bowl through a ball valve down into the cylinder space so formed. On the 'down' stroke of the handle, the ball valve closes as the piston moves up, and emulsion is forced out between the faces of the floating valve and its seating which lies within the hollow piston (B.P. 476556). The valve is spring-loaded and adjusted by means of a screwed member which incorporates a drip cup.

It should be noted that the performance test of this emulsifier by Johnson and Morse (1934) is hardly relevant in considering its capabilities, as the machine

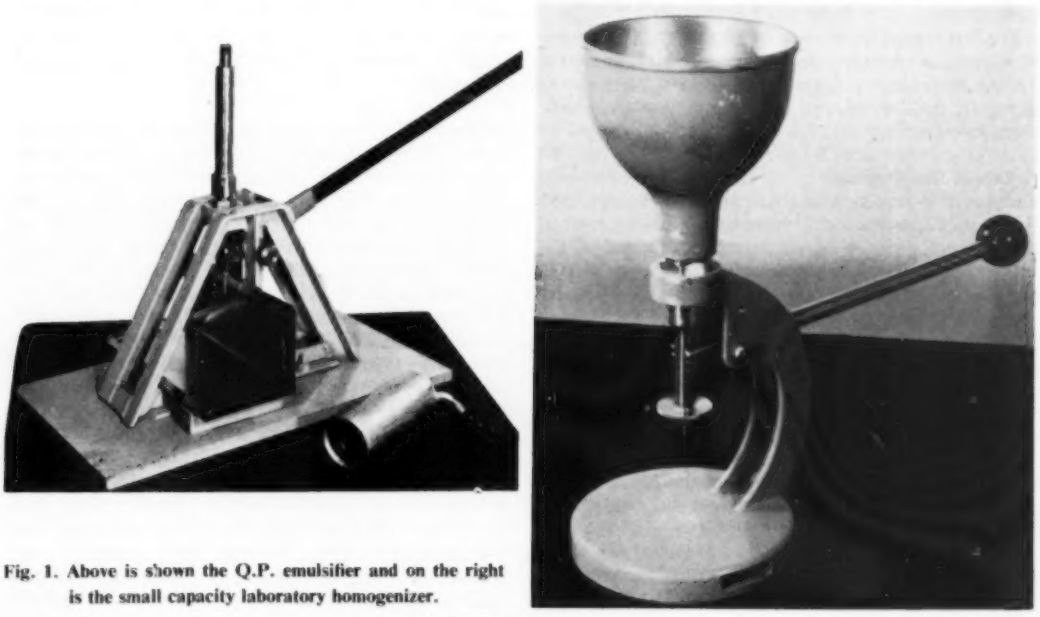

Fig. 1. Above is shown the Q.P. emulsifier and on the right is the small capacity laboratory homogenizer.

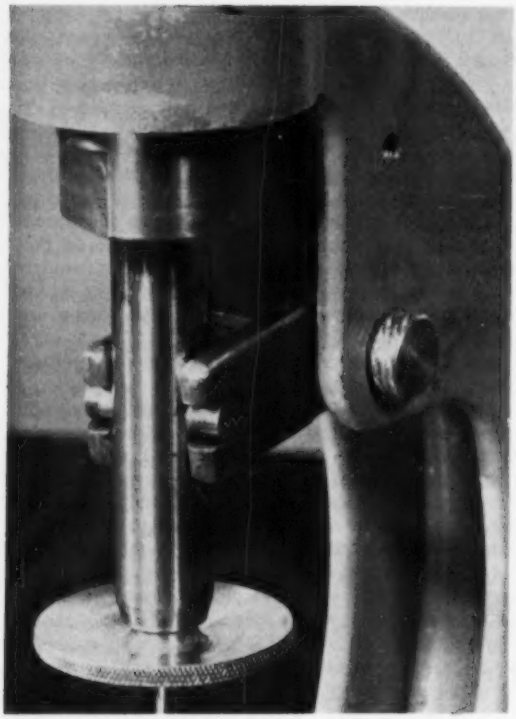

Fig. 2(a). Pumping handle/piston coupling on the Q.P. emulsifier.

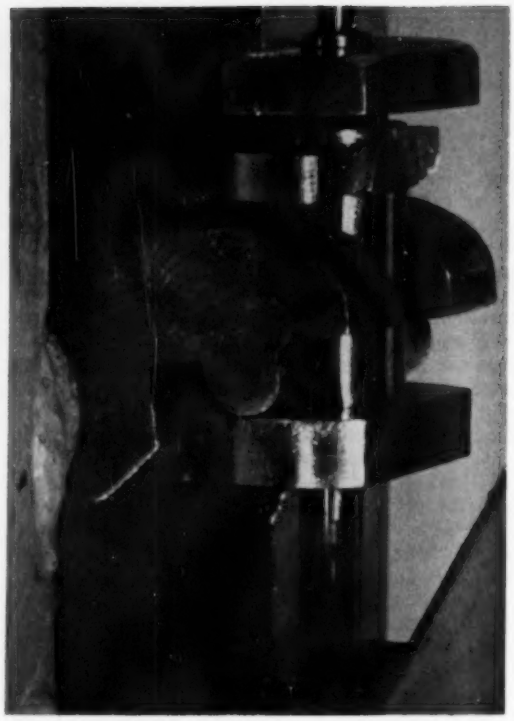

Fig. 2(b). Pumping handle/piston coupling on modified machine.

tested had a homogenizing orifice and not a spring-loaded valve.

This basic emulsifier design was modified in a number of ways to suit our own requirements. General views of the Q.P. emulsifier and the modified version are shown in Fig. 1. Both models require clamping to the bench when in use.

Details of Construction

Framework.—In order to obtain the very fine particle size required, considerably more pressure was required at the homogenizing valve than the strength of the original emulsifier frame allowed. A framework of 1 in. angle iron was therefore made with a threaded housing into which the cylinder could be screwed.

Pumping Handle.—This was made of 1 in. × $\frac{3}{8}$ in. mild steel and about 3 ft. long. The distance from the fulcrum to the rounded shoulders bearing on the piston was about $1\frac{1}{2}$ in. The fulcrum pin was a $\frac{1}{2}$ in. diameter rod of silver steel. The original design for engaging the end of the pumping handle with lugs on the piston (Fig. 2 (a)), was altered to provide a stronger coupling (Fig. 2 (b)).

Piston and Cylinder.—These were of stainless steel and brass respectively. Two sizes were made, one to the original piston size of a nominal $\frac{5}{16}$ in. diameter and another of $\frac{1}{4}$ in. diameter. Rubber O-rings of 90° Shore hardness were fitted to the pistons, with Fluon backing rings to prevent extrusion of the O-rings at high pressures.

Homogenizing Valve.—The region where homogenization of the emulsion takes place lies within the piston, where the emulsion is forced between, and across, the plane faces of the valve and its seating (Fig. 3). The standard design and size of valve were employed for the larger capacity arrangement. A model of smaller dimensions was fitted to the $\frac{1}{4}$ in. assembly. The valve was screwed on to its seating directly by the stem of a stainless steel drip cup which was machined with flats to enable a spanner to be used for adjustment. A short outlet tube was fitted to the cup. The usual spring (shown in Fig. 3) for loading the valve was omitted. In the absence of spring loading it is apparent that flow of emulsion through the valve relies on imperfect mating of the valve and seating surfaces. No attempt was made to machine any grooves in the surfaces. The procedure adopted was to lap the two surfaces together so that when the valve was screwed up as tightly as possible, emulsion was prevented from flowing when pumping was attempted. Using a spanner, the drip cup was then adjusted fractionally to allow emulsion to be pumped

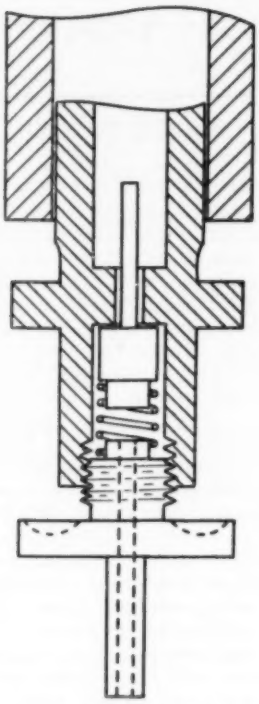

Fig. 3. Cross-section of the piston showing the spring-loaded homogenizer valve in position.

through at a satisfactory pressure and rate. The adjustment was critical and, in some cases a brass washer, fitted on the valve stem and interposed between the two surfaces, provided a slight 'give' and made adjustment easier. A small steel ball is normally fitted inside the Q.P. emulsifier piston so as to close the seating and prevent emulsion flowing should the valve be removed for cleaning. This was omitted in the modified version.

Emulsion Bowl.—For processing amounts of 15 to 50 ml., the larger piston assembly was used and the original emulsion bowl replaced with a cylindrical stainless steel vessel about 6 in. long and 1 in. bore. As in the original machine, the ball valve was housed in the bottom of the vessel, being firmly held in place when the latter was tightened on to the cylinder with a spanner. Fibre washers above and below the ball-valve casing provided effective pressure seals. A smaller stainless steel vessel of $\frac{1}{2}$ in. bore could be screwed into the larger one to lie concentric with it when amounts less than 15 ml. were to be homogenized with the $\frac{1}{4}$ in. piston assembly. A ball valve with smaller exit holes was then used.

Temperature Control.—To warm those emulsions which homogenize more readily above room temperature, a 100 watt heating tape wound on a brass former could be slipped over the larger emulsion vessel and the heating controlled by means of an energy regulator. The annular space between the outer and inner vessels was filled with water. Hot water, without additional heating, was sometimes found adequate where processing could be accomplished in a few minutes.

Discussion

Homogenizing with the larger assembly, the full length (3 ft.) pumping handle was used, giving a velocity ratio of about 26. When using the smaller components, a shortened hold on the handle was taken, reducing the velocity ratio to about 18. Unfortunately no means was available for directly measuring the pressures developed in the cylinder during pumping. Measurements of the effort applied to the shortened handle through a spring balance showed maximum loads of about 40 lb. weight. The efficiency of a machine of this kind is difficult to assess, but if it is assumed to be 50 per cent, and taking the velocity ratio of 18 above, the maximum pressure developed in the cylinder each stroke is calculated to be about 7,000 p.s.i. Although appearing rather high, this pressure would not be sustained throughout each stroke and the average pressure of pumping must be less than this. Some credence for the existence of these high pressures during pumping is afforded by the results obtained on milk and an emulsion of olive oil (Table I).

As the makers of the original machine point out, the speed of pumping has a considerable effect on the emulsion. Generally a rate of 60 to 90 strokes per minute with vigorous down-strokes gave the best results. Little or no air was incorporated in the emulsions.

In order to produce the finest and most uniform dispersions, it was generally necessary to pump the emulsion through the machine a few times, the actual number depending upon the system to be processed. This involved returning the emulsion to its container by hand after each passage through the machine (batch method). This could be avoided by connecting a rubber tube from the outlet of the piston, back to the supply container, so recirculating the emulsion and enabling pumping to be continuous. The continuous mixing of homogenized emulsion with the coarser supply, however, is a less efficient means of processing, and for results comparable with the batch method, pumping has to be prolonged.

In testing the efficiency of the homogenizer, the optical test for emulsions devised by Goulden (1958; 1960) was used in conjunction with cursory microscope examinations. The optical test involves measuring the turbidity index (T) of a diluted sample of the homogenized emulsion at a wavelength of 0·9 μ. This gives a measure of the size distribution of globules in the emulsion and is a sensitive indicator of the degree of homogenization. With milk a quantity of NaOH must be added in order tc solubilize the protein and eliminate its contribution to the overall turbidity.

The performance of the homogenizer with the small

TABLE I

Test of homogenizer performance

Emulsion		*Times through Homogenizer*	*Processing Temp. °C.*	*T Index*
A Olive Oil	(2%)	4 × Laboratory homogenizer	70°	4·5
B Milk	(4%)	4 × Laboratory homogenizer	50°	4·1
C Milk	(4%)	4 × at 3,000 p.s.i. Commercial homogenizer	50°	9·8
D 'Lipomul I.V.'	(2%)	Equivalent to 4 × at 4,000 p.s.i. Commercial homogenizer	70°	6·5

piston assembly, using the batch method, can be gauged from the data in Table I.

In these experiments, the smaller the T index, the greater the degree of dispersion. Differences in fat percentage are allowed for in the calculation of T.

Emulsion A was a dispersion of olive oil in glucose solution with lecithin and Pluronic F68 (polyoxyethyleneoxypropylene polymer) as emulsion stabilizers. A coarse emulsion was first formed from the separate phases by mixing them hot in a high-speed whisk. After standing for a few minutes to allow the small amount of occluded air to separate off, the emulsion was passed four times through the homogenizer. A fresh milk sample B was also treated four times.

The milk C was homogenized in the Institute's dairy by passing it four times through a 3-piston 'Rannie' machine at 3,000 p.s.i.

For further comparison, the T index of a diluted cotton-seed oil emulsion D from an American source was determined. Under the microscope, this dispersion appeared very uniform with droplet diameters slightly less than 0·5 μ, but with an occasional 1 μ particle. A relatively large scale production method was used for preparing this particular emulsion in about 200 litre quantities (see U.S. Patent No. 2,870,019, 1959). The T value is noticeably higher than for A and B.

The spread of the droplet size distributions in these emulsions was quite small and if we assume that the emulsions were, in fact, monodisperse then an idea of the sensitiveness of the test to changes in droplet size can be determined. Calculation (Goulden and Phipps, 1960) shows that a change in T of about 6 in this size region, corresponds roughly to a change of 0·25 μ in droplet diameter. An examination of milk C under the microscope showed that the average diameter of the fat droplets was about 0·5 μ. It follows that, comparing T values, the average droplet diameters in emulsions A and B were about 0·25 μ. The fat drops in A and B were, in fact, so small as to be barely discernible under conditions of full magnification using monochromatic light, and were thus probably in the region of 0·25 μ in diameter, the approximate limit of the resolving power of the microscope. The value of the T test, which is still applicable to these near-invisible particles, is apparent in this case.

The minimum volume of material which it has been found possible to homogenize successfully, is about 3 ml. When working with these volumes, the small amount trapped in the cylinder is worth recovering; this may be released by slackening the drip cup. As some is bound to adhere to the walls of the machine, complete recovery of the emulsion is not possible. This is particularly so for viscous materials. Evaporation of moisture during high temperature processing can also limit the volume recovered as well as alter the phase volume ratios.

Dairy creams of up to 30 per cent fat content have been satisfactorily homogenized, and success with thicker products could be expected.

ACKNOWLEDGMENTS.—*The writer is indebted to Mr. P. Austen for making the homogenizer and for the design of the piston/handle coupling, to Mr. S. F. Suffolk for his helpful suggestions and to Mr. N. Gruber and Mr. A. Barkus for the photographs.*

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APPARATUS AND DEVICES

It is evident from letters received that the Apparatus and Devices Section of *Laboratory Practice* arouses considerable interest. We should like to point out that we are at all times pleased to receive from readers notes, however short or simple, for inclusion in this section.

AN ACCIDENT PROOF BOTTLE LIFTER AND CARRIER

by H. A. Malcolm

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ONE of the problems associated with the treatment of patients by radioisotopes is the safe handling and carrying of containers used for the collection of radioactive urine. In this Department the urine is collected and stored in Winchester type bottles of clear glass with screw cap tops of bakelite. The safe transportation of these bottles from patient to counting room and urine disposal unit has been facilitated by the design and construction of the 'lifter and carrier' described herein. The mode of operation and construction may be seen from Fig. 1, 2, 3 and 4.

In Fig. 3 and 4 can be seen the original design of lifter which was for use with narrow necked Winchesters, while Fig. 1 and 2 show the same design adapted for wide necked Winchesters. The latter is one of a range of bottles which employs the same size neck, mouth and screw cap top and it is the largest of this range, the 80 oz. capacity bottle, which is used in this Department*. Fig. 1 and 3 show the lifter in position holding the bottle. Fig. 2 and 4 illustrate the lifter with lower release handle pulled up, the jointed arms akimbo and the inner tapered collar pulled open by the tension springs.

To operate, the lifter is held in the hand by the topmost handle and the collar end applied to the neck of the bottle which will be resting on the floor or bench. This applied action causes the inner tapered split collar to rise within the outer locking ring until there is a sufficiently wide opening for the top of the bottle to enter. Once the neck of the bottle has completely slipped into position the bottle is now ready to be lifted. With the lifters still held by the top handle, the action of lifting pulls the outer ring (which is tapered inside to match the outside taper of the inner split collar) upwards, thus firmly grasping the inner collar round the bottle neck just below the flange.

To release the bottle from the carrying position the weight of the bottle must be completely taken up by the floor or bench, otherwise the lifters cannot be released.

When the weight of the bottle has been taken up, a slight downwards pressure on the top handle combined with an upwards pull on the release handle will splay the jointed arms by means of the splaying bar as illustrated in Fig. 2 and 4. This action pulls the inner collar outwards and upwards *via* the tension springs which are attached to the jointed arms, thus releasing the bottle neck. (The inner collar is prevented from slipping completely through the outer ring by the small hinge at the bottom). The total lifter assembly can now be removed from the bottle.

The jointed arms are made of silver steel, the collar and locking ring of phosphor bronze and the handles of laminated Bakelite, thus making for sturdy construction. The carriers used are one foot long and apart from the bakelite handles the whole assembly is chromium plated, giving a surface which is easily decontaminated, should this be found necessary.

Any carrying tool for bottles containing radioactive solutions must meet several requirements:

(*a*) It must be safe in operation, i.e. accident-proof to the extent that once the bottle is held in position of carrying, it cannot be released either by accident *or intent*.

(*b*) It must be sturdy in construction and simple to operate by lay personnel as well as technical staff.

(*c*) It must be of sufficient length to take full advan-

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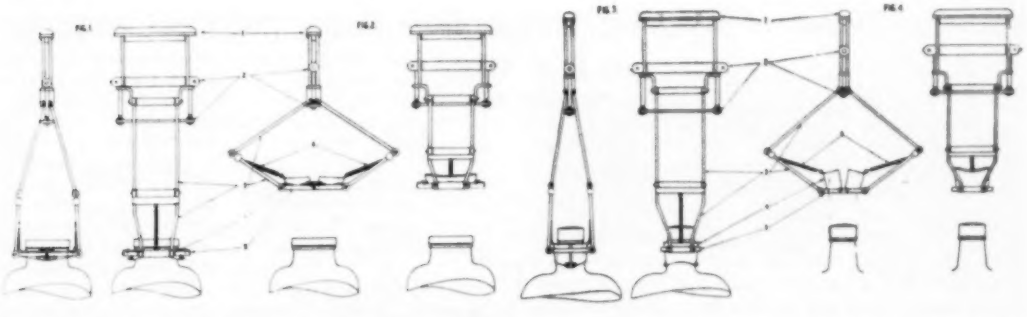
*Baird and Tatlock (London) Ltd. B15/035 Bottles, wide-mouth pattern. 12, 16, 20, 24, 32, 64 and 80 oz. have same neck and cap size.



In Fig. 1–4 above: 1. Carrying handle. 2. Release handle and splaying bar. 3. Jointed arms. 4. Outer tapered locking ring. 5. Inner tapered split collar. 6. Tension springs.

A USEFUL ADJUNCT IN ELECTROMETRIC DETERMINATION OF pH

by W. J. Roff

British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester, 20

WHEN using a pH meter it is necessary to ensure that the electrodes are free from contamination with the solution previously employed, particularly in changing from a buffered solution to an unbuffered one. Under certain conditions the tap or sleeve usually incorporated in the calomel half-cell can give trouble in this respect, but the difficulty is overcome in an arrangement here described. Although no special novelty is claimed, the apparatus (Fig. 1) permits a fresh and well-defined liquid junction to be made in a reproducible way, and it has proved very satisfactory and convenient in use.

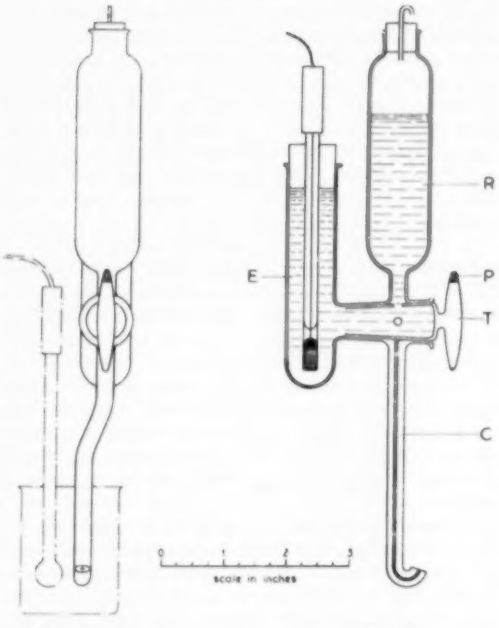
C is a thick-walled capillary tube (0·5 mm. or less in internal diameter) functioning as a potassium chloride bridge, and R is an ample reservoir for the solution. The mercury/calomel element is placed in the rear compartment, E, and may be assembled in the conventional manner or be of the pencil type available commercially. The three sections are connected through the tap, T, tipped with a reference pointer, P.

The barrel of the tap is hollow and is open at the narrow end, and holes are drilled through it in positions such that the apparatus functions as follows:

(i) *Pointer vertically upwards.* This is the position in which the tap should be left after use (and with the lower end of the capillary tube kept under distilled water). In this condition E is isolated from C but connected to R to allow for any change in volume.

(ii) *Pointer horizontal.* This connects E, R and C, allowing potassium chloride solution to flow from R and flush the capillary of C.

(iii) *Pointer vertically downwards.* This isolates R and stops the flow of electrolyte, but leaves E connected directly with C, ready for measurement.



Front view. **Side view.**

The bottom of the capillary tube is normally bent upwards as shown, which prevents displacement of the potassium chloride solution, but the bend should be omitted if the apparatus is to be used in solutions of density greater than that of the potassium chloride solution.

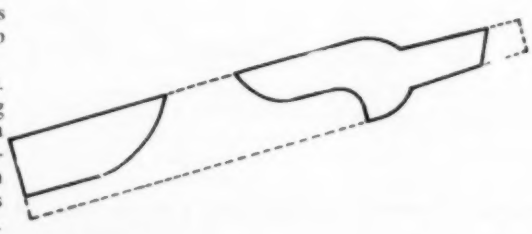
The Manufacture of Weighing Troughs from Empty Polythene Ampoules

by B. P. Shepherd

Horley, Surrey

THE empty polythene ampoules used as containers for volumetric concentrates can be converted into ideal weighing troughs when suitably cut.

Two may be prepared from one ampoule (Fig. 1). One of these becomes a simple pliable scoop enabling solids to be easily directed into a receiver with a minimum of retention. The second part forms a funnel-necked scoop which can be used for washing solids in the volumetric flasks and other vessels. These items have proved to be most serviceable in our laboratory.



CELL CLEANING APPARATUS

by D. W. Fripp, B.Sc.

and B. D. Powell, M.A., Ph.D.

Cadbury Brothers Ltd., Bournville, Birmingham

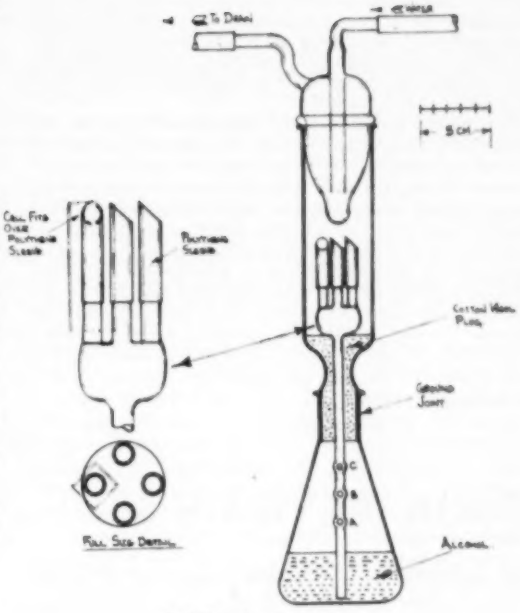
A SIMPLE apparatus has been designed for cleaning the 1 cm.^{2} absorption cells used in spectrophotometers with a jet of vapour from boiling methyl alcohol.

Vapour enters the vertical tube, which is held in position by a tight plug of cotton-wool, through the holes, A, B, and C, and issues from four jets, over each of which a cell is inverted. The water cooled finger condenser is a loose fit and condensed alcohol returns to the 350 ml. conical flask through the plug.

A sleeve of polythene is fitted over each jet, preventing the cells from becoming scratched, and with an obliquely cut end to the sleeve the cell can be supported and the flow of vapour left unimpaired.

After lifting the condenser clear, cells may be inserted and removed with the aid of a pair of tongs having suitably protected tips.

ACKNOWLEDGMENT.—*We are indebted to Mr. W. A. Blower for constructing the apparatus.*



Cell cleaning apparatus.

PARTICLE SIZE CONTROL IN AQUEOUS DISPERSIONS

MODERN industry is always on the look out for techniques for rapid and precise determination of particle size distributions in fluids. Until recently there have been two main approaches to this problem. They are techniques based on Stokes Law settling, and optical or electron microscopy.

Stokes Law settling techniques are difficult when the particle density differs only slightly from that of the medium and where the medium itself is of ill-defined composition.

Microscopy presents difficulties because of the very small size of the samples viewed compared with the bulk, and the subjective nature of visual appraisal of size. Scanning techniques have been developed to improve the reliability of microscopy as an approach to size determination but difficulties of sampling and changes in size due to the pressure of cover slips, surface tension and drying effects remain.

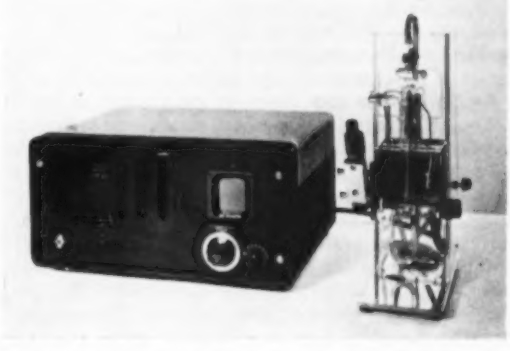
The National Cash Register Company have encountered this problem in the manufacture of microscopic ink containing capsules which are coated on paper to produce 'No Carbon Required Paper'.

In the process, a solution of suitable colour reactants in oil is emulsified in gelatin and coacervated in the presence of gum arabic by a suitable acidification technique. The oil drops form aggregates coated with gelatin which can be hardened at a later stage in the process.

The 'emulsion' is mixed with certain other ingredients for the purpose of facilitating adhesion to paper and protecting the microscopic capsules from damage. It is applied to paper by means of an air knife coating machine.

Multiple copies can be obtained from this paper by interleaving it with clay coated paper of a suitable nature.

It has been found that the size of the oil-containing capsular aggregates plays an important role in obtaining maximum transfer of the encapsulated oil to the clay coated receiving sheet where a print develops, without introducing adventitious transfers due to handling, either in manufacture or use. As a rule of thumb it has been found that the model



The Coulter counter for faster and more accurate fine particle measurement in medicine and industry.

size should be 11 microns with no more than 5 per cent above 20 microns. In other words a degree of size control almost unattainable by microscopy or sedimentation, is required routinely in a manufacturing operation resulting in annual turnover of coated paper valued at £1,000,000 and representing a tonnage of 3,500 tons.

The required particle size control is attained by the use of a device which sizes particles by the change in electrical resistance accompanying their passage through a tiny hole of the order of only five to 10 times the diameter of the average particle size to be counted. The instrument is manufactured in England by Coulter Electronics Ltd.*

In the N.C.R. emulsion manufacture, a number of lots of emulsion are manufactured in a batchwise fashion and blended together for shipment. Care and judgment of the plant operator at the coacervation stage are most important because the size distribution depends on the degree of acidification carried out at this stage. A trained operator can tell by microscopic observation when he is there, but needs to supplement his subjective judgment by reference to a test on the Coulter counter.

A sample is taken from each batch and the proportion of particles smaller than 10 microns and larger than 20 microns is determined and entered into the process log with the operator's initials. The blend for shipment to the Paper Company is also subjected to this test together with a determination of the median size, the size below and above which there are an equal number of particles. It corresponds fairly well to the model or most probable size for symmetrical size distributions.

It is possible to determine the median size by making at the most, six counts at 1 micron intervals from 9 microns and interpolating to obtain the size corresponding to half the total number of particles.

N.C.R. emulsions are mostly symmetrical and even when they depart from symmetry it is found that the median size is a good indication of their likely performance when coated.

*U.K. Patent No. 722418.

BOOK REVIEWS

The Anti-globulin (Coombs) Test in Laboratory Practice, by I. Dunsford, Ph.D., M.I.Biol. and Jean Grant, F.R.C.P. Edinburgh: Oliver and Boyd. 1959. 12s. 6d. pp. 120 + xiii.

The anti-globulin test was first conceived in 1908 by Carlo Moreschi, but was devised in its present form and application by Coombs, Mourant and Race in 1945. Since then it has been used extensively in the laboratory study of various aspects of immunology.

Dunsford and Grant have reviewed the test, and have shown its value and its limitations—their book is not intended to be a comprehensive review of the enormous literature which has developed around the test although their 150 references include most of the more important contributions to the subject. Their main objective has been to introduce the test to workers in widely divergent sciences.

There is an elementary but clear and concise introduction to antigens and antibodies, which will be useful to anyone not familiar with this field, and this should provide an understanding that is necessary for an appreciation of the serological basis of the anti-globulin test.

As the authors say, although the number of anti-globulin tests performed each day must be considerable and the amount of experience gained over the past 13 years should have led to the development of foolproof methods, it remains largely an experimental technique which is fraught with difficulty. From their own practical experience with the test the authors are well qualified to know the many possible pitfalls associated with each phase and to advise on how to avoid them. It is as a practical manual that the book is especially useful.

As the authors have been concerned primarily with blood transfusion work, it is not surprising that the most detailed and useful section of the book is on the application of the test to blood group serology and transfusion. Haemolytic anaemias, on the other hand, are treated more cursorily; thus, while anti-globulin inhibition technique is discussed in a later chapter, the value of gamma and non gamma globulin neutralization tests in acquired haemolytic anaemias is not mentioned. The use of the anti-globulin test in fields other than haematology is described and some key references are given concerning its application in the fields of bacteriology, forensic medicine, veterinary and immunological research, and some unusual applications, such as in cancer, in lead poisoning and for the estimation of globulins in serum and other fluids.

This book achieves its self-limited aim, and as an introduction to the subject it should be of value to workers in several fields. It is well worth its very reasonable price.—S. M. LEWIS

Food Directory 1959-1960, edited by R. De Giacomi, A.R.I.C. London: Tothill Press Limited. 1959. 40s.

The general form of the fourth edition of this most useful publication is unchanged. It has, however, been enlarged and now contains 845 pages compared with 758 in the third edition. The main sections are Food Manufacturers, Commodities, Plant and Equipment, Packaging Materials, Brand Names, Food Laws and Consultants practising in the food industry.

Each of the first four is divided into two parts, the first giving the names, addresses and telephone numbers of the firms, and the second a classified list of the materials or products made or sold by them. The Food Manufacturers section reflects the changes in pattern within the industry which have occurred since the last edition through the regrouping and amalgamations which have occurred.

The growth of the quick-frozen food industry in the last two years is reflected in the formation of many new

companies and the number of headings for quick-frozen foods has correspondingly increased.

The summary of food standards and regulations in many countries in addition to the United Kingdom prepared by C. L. Hinton is of particular value. The addition of summaries for six countries not previously included brings the total up to 57, and this section could with advantage be expanded still further. For example, bacteriological standards could be included to a greater extent. Information of this nature in a compact and easily available form has been found especially useful by the reviewer.

The recent alterations made in various countries in the permitted lists of colouring matters are shown in the Table of Official Permitted Colours.

Other sections of the Directory give information about Government departments, food research organizations, trade associations, and schools and colleges with full time specialized courses in food technology.—J. G. DAVIS.

An Electronic Outline of Organic Chemistry, by S. Horwood Tucker, M.A.(Oxon.), D.Sc. (Lond.), Ph.D., F.R.I.C., A.R.C.Sc. London: University of London Press Ltd. 1959. 63s. pp. 478 + xvi.

This work is a didactic and somewhat dogmatic account of the manner in which the electronic theories of valency may be applied over a wide range of organic chemistry. It is specifically designed for students and the aim seems to have been to convince them that the theories are general. It is therefore more like a memoir, submitting a case for consideration and approval, than a text-book designed to inculcate general principle. It does not give sufficient opportunity for independent judgment of the cases mentioned by a deep analysis of the experimental basis and the development of the argument.

The work will be found excellent by those students who like to be spoon-fed with small doses of sweetmeats, but it is not suited for the more robust type of enquiring mind; the kind that requires to be convinced and is not content to accept ready-made concepts. The book will serve well for occasional reference provided that the reader has studied the subject for himself elsewhere and is ready to take its assertions *cum grano salis*. This criticism does not imply that the conclusions are not acceptable. Apart from the retrogressive, almost constant use of fully ionized atoms and groups, the mechanisms suggested are very likely to be correct to a first approximation.

The exposition improves, paradoxically enough, when the writer gets away from pure electronics. Thus the chapters on Sugars, Knoevenagel Reaction types, Optical Activity and the Walden Inversion, and several similar sections are both readable and instructive.

The historical accounts of origins of the electronic theories in organic chemistry are quite inadequate and consistently either plain erroneous or misleading.

As the reviewer is concerned, he cannot make a Strindberg of the matter on this occasion but will content himself with the references to Lowry's suggestions. Dr. Tucker states that the theories originated with Lapworth and Lowry and were extended by Robinson and Ingold. But the work of Lapworth and Robinson proceeded along parallel lines contemporaneously, the former from the electro-chemical aspect, and the latter from a partial valency theory, early considered in electronic interpretation. These streams converged in 1921-2 and led to a system of organic chemistry which has been variously interpreted with increased understanding of physical electronic theory, but has not been fundamentally modified. Neither Lowry nor Ingold introduced new conceptions though the latter invented new nomenclature and, as is well known, made brilliant and far-reaching contributions to the study of mechanism.

Dr. Tucker seems to be unaware of the nature of Lowry's theories and attributes ideas to him which he not only never advanced, but which he even repudiated.

On page 25 our author states that the notion of electron displacement and even conjugated electron displacement in unsaturated systems originated with Lowry. This error shows that the original literature has not been sufficiently carefully studied. Lowry's views are misrepresented and our own symbols are here attributed to him. What is worse, the real origin of the idea of conjugated electronic displacement is completely lost to view in the process. In point of fact, Lowry wrote $\overset{+}{C}H_2-\overset{-}{C}H_2$ for ethylene and $\overset{+}{C}H_2-CH=CH-\overset{-}{C}H_2$ for butadiene. He never used, as Dr. Tucker claims he did, the Robinson symbols

$$CH_2=\overset{\curvearrowright}{CH_2} \text{ and } CH_2=\overset{\curvearrowright}{CH}-CH=\overset{\curvearrowright}{CH_2}$$

Indeed, Lowry made a merit of this reversion to the expressions of Fry and his words may be cited from J. Chem. Soc., 1923, 123, 822, the paper to which Dr. Tucker refers:

'(b) The electronic formulae of Lapworth and of Kermack and Robinson give, when analysed, an excess or deficit of half an electron on the terminal atoms of a conjugated chain, but make the intermediate atoms neutral. The new formulae, on the other hand, indicate that, whilst the main polarity and unsaturation are at the ends of the chain, the alternate polarities and unsaturation exists also in the intermediate atoms.'

Dr. Tucker goes so far as to attribute the explanation of the C = C — N (and analogous types) system to Lowry and with this he was never concerned. It was forecast Thiele-wise by Decker and interpreted electronically by the reviewer.

Lowry's views were published after the schemes of Lapworth and of Robinson had been adumbrated. He called them a 'child's guide to polarity theories'. But Lapworth and Robinson were not gratified by this tribute. On the contrary, later in the year they jointly wrote (J. of the Faraday Soc., 1923, *XIX*, No. 56):

'There are theoretical difficulties also, and even a certain doubt as to what the theory of "mixed double

bonds" really implies. The remark that *a double bond in organic chemistry usually reacts as if it contained one covalency and one electrovalency is*, with its double qualification, unexceptionable, being no more than a restatement of the fact that unsaturated compounds undergo polar additive reactions—sometimes. It might, of course be taken to imply a readiness to accept the theory of "activated molecular phases," which the present writers in most cases employ, but this is not clear, and in all the remainder of the paper (loc. cit. 1923) from which the quotation has been taken definite electrovalencies are allotted to all unsaturated compounds. Indeed, this adoption of completely polarised unsaturated linkages is what confers novelty on Professor Lowry's views, and at the same time it is the feature of them to which we take exception. It should be mentioned that graded electrovalencies appearing in activated molecules, and possibly in normal molecules containing carbonyl and similar unsymmetrical groups, were postulated by both of us prior to the appearance of Professor Lowry's papers.'

These and other serious distortions of the historical record, too numerous to mention, are a blemish in what is otherwise a sincere and not unsuccessful attempt to demonstrate the general utility of electronic theories in organic chemistry. The book is well printed and the proofs have been carefully corrected. The price will make the book an expensive item of equipment for students and the greater part of the cost of production could have been saved by avoidance of the multiplication of instances and by giving more space to explanations which would enable the readers to work out many of the applications for themselves.—ROBERT ROBINSON.

Laboratory Instruments, Their Design and Application, revised by A. Elliott, PH.D., D.SC., and J. Home Dickson, M.SC. 2nd edition. London: Chapman & Hall Ltd. 1959. 55s. pp. 514 + xvi.

'Do it yourself' is a phrase which we have heard very frequently in the past few years, but it is one which has been anticipated for a long time by experimental scientists, who construct much of their apparatus for themselves. They do this partly because of tradition, partly because of the long time it takes to have special apparatus made by the instrument industry, and partly because few of them know the true cost of what they make themselves. If more attention were paid to this last point, fewer competent scientists would spend their time acting as mediocre instrument mechanics. It is a good rule never to make what can readily be bought in a satisfactory form.

Be this as it may, there will inevitably remain many occasions on which instruments must be constructed or modified in the laboratory workshop; and there is as much 'know-how' involved in the design of an instrument as in the design of a complex experiment. In either, neglect of the basic principles, or ignorance of the craftsman's methods, will seriously detract from the results obtained, consuming both time and effort. As Elliott and Dickson say in the preface to the first edition (1951) of this book '. . . the worker is often called upon to design and construct his own instruments or to guide others in their construction, and he finds his training inadequate to cover the many ramifications involved in this aspect of the work. The chief aim (of the book) has been to present the principles on which good design is based, and many examples have been given. No attempt has been made to cover the entire field of instrument design, but the authors have endeavoured throughout to show the inter-relation of good design, material, and method of construction, so that the best results may be obtained with moderate or limited means.'

The second edition of this book closely follows the scheme of the original, with some valuable additions. The authors confine themselves to mechanical and optical topics, since, as they say, any adequate treatment of electronic instruments would have made the scope of the book too wide. They start with consideration of basic fabrication methods and the properties of materials commonly used in instruments, and pass via a chapter on drawings to discussion of a variety of mechanical topics. Sections on glass and other optical materials lead to consideration of optical and other radiation instruments, and there are final chapters on photography and corrosion.

This brief outline does scant justice to the value of the book. As well as descriptive matter, stimulating to read and invaluable to the beginner, there are many pages of tables and diagrams which make this a most useful reference work. The chapter on Constrained Motion should be studied carefully and brought to the attention of any draughtsman who may be employed on instrument work, for the well verified principles which it expounds are very commonly ignored. A new chapter on corrosion will be particularly useful to those designers whose instruments have to stand up to damp or fume laden atmospheres.

The authors do excellently what they claim to do, but there are inevitably gaps in a compilation of this sort, which does not set out to be encyclopaedic. Electronic instruments have been ruled out, and the ban has been extended to cover nearly all electrical topics. This must be deliberate, but a strong argument could be advanced for some discussion of the 'electrics' which form a part of many non-electronic instruments. On the mechanical side, gear trains have probably been considered a too specialized topic for inclusion, but one might well have hoped to find reference to torsional suspensions and to vacuum technology.

These are quibbles however, and not to be taken as attempts to detract from the value of the book. A copy should be available to everyone who attempts as an amateur to design scientific instruments; and he would be a rash professional who maintained that he could obtain no benefit from it, either through study or reference.—ROSTRON HINDLEY.

REORGANIZING BRITISH RAILWAYS RESEARCH

New Laboratories Opened in London

NEW British Railways laboratories, built on the site of the former Alexandra Palace railway station at Muswell Hill, London, were formally opened on March 11 by Sir Brian Robertson, Chairman of the British Transport Commission.

The new building contains laboratories and offices for the Chemical Services and completes the first stage in the reorganization and expansion of the British Railways Research Department. This reorganization is being undertaken to give the most up to date and economical research service for the railways and, when required, for other undertakings of the British Transport Commission.

Since 1951, the activities of about 12 chemical laboratories which were inherited by the Commission from the former railway companies have been co-ordinated. Most of these laboratories were unsuitable for modern needs, and, as it has become increasingly necessary to provide specialized and expensive instruments, which are only economical if they are given the widest use centrally, it is intended to concentrate the Chemical Service in fewer laboratories at centres which will serve all parts of the railway system.

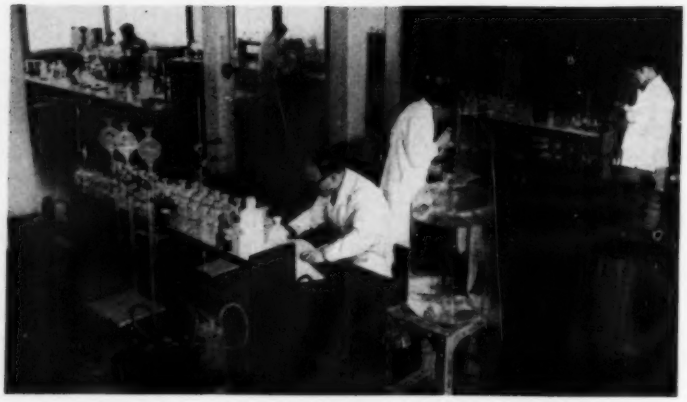
The new building at Muswell Hill, which is the first of these centres, accommodates the headquarters' staff of the Chemical Services, the London Area Chemical Laboratory, the Building Materials Laboratory and the Corrosion Laboratory, which were formerly at Euston, Stonebridge Park, Wimbledon, and Derby respectively. It also replaces the Stratford Laboratories of the former L.N.E.R., which were destroyed by enemy bombing during the last war.

The London Area Chemical Laboratory serves a large territory extending to Sheerness, Aldershot, Reading, Oxford, Leamington, Rugby, Peterborough and the Wash. It undertakes the routine testing of materials other than textiles; claims investigations into the causes of damage to goods in transit, and accidents involving dangerous goods; laboratory investigations for the B.T.C. Police; the examination of water supplies, fuel, and foodstuffs; and the control of chemical manufacturing processes such as oil blending, train lighting battery manufacture, electroplating, etc. and research problems arising in these fields.

The Corrosion and Building Materials Laboratories serve all parts of British Railways. In the former are investigated problems of metallic corrosion in structures and equipment exposed to exceptionally severe conditions, and advice is given on the use of methods and materials of construction which may prevent corrosion and so result in financial saving. Since the large-scale adoption of diesel traction, particular attention has been devoted to corrosion in the cooling systems of diesel locomotives. In the Building Materials Laboratory investigations are carried out on new materials and in the rectification of defects in existing structures, e.g. the reinforcement of decayed brickwork. Research is also carried out into improvements in special acid and corrosion resisting cements and other materials.

The new building at Muswell Hill, which has three storeys, including a semi-basement, is sited and designed to comply with local town planning requirements. It is constructed of reinforced concrete, faced with golden brown bricks, and there are panels of blue-grey ribbed slate set in artificial stone surrounds under the main laboratory windows on the first floor. The roof is flat for carrying out weathering tests of materials, and is equipped with penthouses containing lift motor equipment, storage tanks, and an office for recording data obtained from the weathering tests.

Most of the laboratory floors are covered with P.V.C. 'Crestaline' or acid resisting tiles, and the walls are in plaster or acid-resisting tiles where processes require such treatment. Ceilings are sound-proof and, in the laboratories, flame resisting. The offices are similarly treated except that the floors have cork tiles. Large windows have been provided for the main laboratories and are fitted with Venetian blinds to



Analytical control, which is the responsibility of the area chemist, is undertaken in the main laboratory.

combat glare and solar heat. Artificial lighting is generally fluorescent.

Benches and fittings in the laboratories have been specially designed for the requirements of each department, and the services, which include water, electricity, gas, compressed air, and vacuum, are distributed by two large vertical ducts extending from the bottom to the top of the building. These are connected below the basement floor by a horizontal duct and under the first floor by a full-width false floor, which allows flexibility in the placing of benches and services.

The semi-basement is designed to provide additional services required by the laboratories on other floors. It contains a washing-up room for the cleaning of glassware and similar apparatus. Store rooms for the main stocks of acids and inflammable liquids are situated outside the building as required by conditions.

In the sampling room, materials of all kinds are ground and sieved, or otherwise reduced, for analysis. Massive materials, however, are first broken down by a crushing machine in the cutting room, which is also equipped with a bench lathe and tools so that a laboratory technician can repair instruments or make specially-designed apparatus. The boiler room has automatically-controlled oil-fired boilers providing hot water for the central-heating system and for bench services in the laboratories. Compressed air for the benches is supplied from an automatically-controlled compressor and reservoir, while telephone and electricity supply equipment have a special switch room, which also contains the electronic circuits for a high-frequency radio communication system for staff location.

There are two laboratories in the semi-basement: one for carrying out corrosion investigations on a large scale, and the other for studying building materials. Preliminary work for the building materials section takes place on this floor. In addition, there is a mixing room where concrete and mortars can be mixed and moulded under controlled conditions. From this room an air-lock gives access to a curing room in which specimens are cured in air saturated with water vapour at a controlled temperature. The design of this room is unusual in that control is effected by a curtain of water flowing down expanded-aluminium sheets on three of the walls. Not only does the water provide the requisite humidity, but it falls from a high level tank fitted with a thermostatically controlled electric heater so that the temperature of the room is also maintained by the water curtain. Water from the curtain is collected and re-circulated. Concrete and mortar specimens are also cured by full immersion in water contained in polyester-glass laminate tanks.

Both the corrosion and building materials sections require to work with aggressive gases and solutions, and these investigations are carried out in a separate room which might be described as a large fume cupboard. An exhaust fan draws the obnoxious gases away at ceiling level.

The ground floor, which is mostly taken up by administrative and other offices, has a spacious entrance hall with an enquiry window for visitors. There is also a conference room, to seat 22 people, and equipped for projection.

The ground floor includes a test room equipped with machines for testing building materials and plastics, and for compression, tensile and bending strength determinations. There are also instruments for measuring the contraction and expansion of specimens under controlled conditions.

The first floor contains most of the laboratories, which are linked by a series of double doors swing. Analytical control which is the responsibility of the area chemist, is mostly undertaken in the main laboratory, sometimes with the assistance of the claims laboratory, and the more specialized investigations of the research laboratory.

The main corrosion laboratory is also on this floor together with the spectrographic and water laboratories. The latter is equipped for both chemical analysis and bacteriological investigations. A balance room and photographic dark room provide a common service for the building, and the technical library is on this floor.

The laboratories are well equipped with electric ovens and furnaces, and with instruments such as photo-electric absorption meters, a polarograph, a flame photometer and a direct-reading spectrograph.

An Accident Proof Bottle Lifter and Carrier

(*Concluded from page* 317)

tage of the protection afforded by distance against any radiation emitted from the bottle, and yet be neither uncomfortable to carry nor vulnerable on stairways.

(*d*) It must discourage direct handling of the bottle neck with the associated possibility of radioactive contamination of hands or gloves.

The apparatus described is thought to comply fully with the foregoing requirements, and during five years of constant accident free use has been found simple to operate by all personnel concerned.

NEW LABORATORIES FOR COIL SPRING RESEARCH

Opening of C.S.F.R.O. Headquarters

New laboratories for the Coil Spring Federation Research Organization at Sheffield were opened on March 24, by Sir Harry Melville, K.C.B., F.R.S., Secretary of the Department of Scientific and Industrial Research. They will enable research to be carried out on springs made from the finest wires to bars of up to 2 in. diameter. In addition to work on springs and torsion bars, research will be possible on materials in wire and strip form and metallurgical investigations will be undertaken on a very wide range of ferrous and non-ferrous alloys.

UNTIL fairly recently springs were made only from carbon steel, a material possessing the prime requirement of high tensile strength. Since the first world war, alloy steels have become increasingly important as spring materials but carbon steel is still widely used.

The spring maker has unique problems, because of the way a spring is loaded or stressed. There are only a very few other applications of metal where the material is stressed in torsion (twisting the metal rather than pulling or bending it). This is the essential reason for the spring industry to carry out its own research—as of course the work of other metallurgical research establishments is not directly applicable.

In the second world war government contracts called for rigid specifications and these were among the first 'standards' to be laid down in the British industry. In 1947 the British Standards Institution introduced its first standard on springs.

Now, it is the Research Organization which very often sets the 'standards' as a result of its investigations. The research programme for the next two or three years contains many important projects but perhaps the most significant is that the ceiling for high temperature research has been raised from 500 °C. to 850 °C.

What sort of problems is the research worker facing? For example, while ambient temperature changes are not serious factors, the atmosphere in which the spring has to operate can be most important as corrosion can accelerate failure. In corrosive atmospheres, such as in a chemical plant, the spring must be protected, either by metallic or non-metallic coatings.

This is not necessarily a straightforward application as it can lead to other problems. One of these is hydrogen embrittlement due to electroplating, in which hydrogen produced during the cleaning and plating processes actually enters the steel, causing premature failure, Some of the earliest work of the C.S.F.R.O. was directed at this problem, producing very valuable information. But the battle is not yet over, and the electroplating equipment donated by W. Canning and Co. Ltd., of Birmingham, will be invaluable in taking the research a stage further, and, it is hoped, finally to a solution.

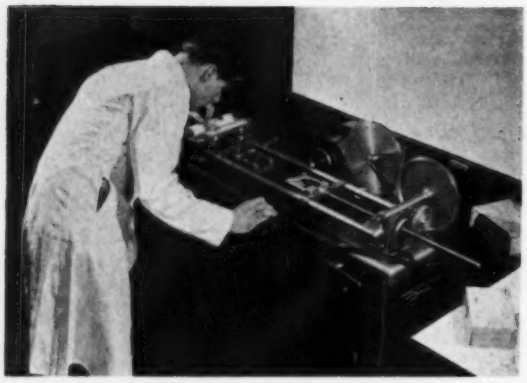
In the field of non-metallic coatings the C.S.F.R.O. is exploring the application of new resinous and plastic materials to springs through an extra-mural project being carried out at the Engineering Department of Imperial College, London.

Another extra-mural project is research into the metallurgy of copper beryllium as a spring material, which is being carried out in the Metallurgy Department of Sheffield University.

For high temperature use the Research Organization is seeking springs which will perform satisfactorily without creep (load loss).

The Director, Mr. R. Haynes, B.Sc., A.Inst.P., A.I.M., and his small team of scientists are also seeking a material with the properties of titanium but with a higher modulus of elasticity. Titanium has high corrosion resistance (more even than stainless steel), high tensile strength and low density. It could be used much more for springs if it had a higher modulus of elasticity and alloying additions can help in this respect. A good deal of research has already been done on alloys of titanium in wire form, and actual springs made of these materials are now being studied.

Rotating-bending fatigue testing of spring wire on a Haigh-Robertson machine.



Determining the tensile properties of a spring wire on the Hounsfield tensometer.

The two-storey laboratory block is probably the most comprehensive of its kind for research into all forms of springs and spring materials.

The ground floor contains laboratories for heavy-fatigue testing, general mechanical testing, experimental heat treatment and electroplating. In the fatigue testing laboratory are housed 12½ h.p. machines capable of applying a dynamic load of nine tons, which are used for fatigue testing heavy coil springs. Up to 18 springs may be tested at one time. Other machines used for fatigue testing springs of the internal combustion engine type are capable of infinitely variable speeds of compression of up to 4,000 per min. A special feature of this laboratory is the sound-proofing and anti-vibration features incorporated in both the suspended ceiling and the floor.

The mechanical testing laboratory houses a variety of conventional machines used for determining the properties of both specimens and springs, covering the range of material diameters 0·004—2·0 in. One machine, for example, is capable of developing a maximum torque of 120,000 lb. in. and is used to investigate the effects of hardenability on the static torsional properties of large-diameter spring steel bars.

There is a comprehensive range of machines, capable of applying static loads from a few ounces up to 30 tons. The determination of fatigue characteristics of drawn wires of diameters 0·01—0·25 in. is provided for by high-speed rotating-beam fatigue machines, which can complete up to 100 million cycles in as little time as one week.

The study of corrosion and protection of spring materials and the effects of hydrogen embrittlement due to electroplating is being continued in a new laboratory specially fitted out for this purpose. Facilities are available for electroplating copper, zinc, tin, cadmium and nickel, and the experimental heat-treatment laboratory is equipped with fully instrumented electric furnaces.

The first floor is devoted to light laboratories (containing small static testing machines, general scientific instruments and equipment), administrative offices, and a conference room. The materials testing laboratory contains machines for determining macro-hardness, tensile and torsional properties of wires and load-deflexion characteristics of small springs. Metallographic facilities are provided in specially fitted rooms for rough sample preparation, fine polishing and etching, microscopical examination and photography.

The laboratories were built at a cost of £22,000 and new equipment totalled another £25,000.

Growth of Heating and Ventilating Research

The efficiency of workers in factories and offices depends very much on their environment. Lighting and colour have been recognized as important factors for many years and a great deal of research has been carried out to develop new techniques. Since the War the effect of heating and ventilation has also come into prominence, calling for up-to-date research on both the effectiveness of the systems in use and their installation and running costs. This need has been emphasized by the size of modern buildings and the importance in the national economy of the large-scale building programmes now being undertaken.

Efforts by the heating and ventilating industry to start co-operative research to study these problems was encouraged by the Department of Scientific and Industrial Research and resulted in the formation late in 1955 of the Heating and Ventilating Research Council. Within four years the Council achieved full Research Association status, and membership now totals 270. A wide variety of research has been undertaken for the industry, now centred in the new laboratories at Bracknell. Much of this is concerned with the design of commercial and industrial installations, but some of the data collected will be relevant to domestic users. At present the work is concerned mainly with scientific and technological investigations, although the Association has started work on problems of productivity. The Association's Council is conscious that there are many other problems which need to be studied and aims to include them in the laboratory's work as the income increases.

Three of the laboratory's major projects are investigations on intermittent heating, chimney design, and the reduction of noise in heating and ventilating systems.

Theory and Practice in the Physical Chemistry Laboratory

(*Concluded from page* 312)

cleanliness can be reduced further by the laying (or spraying) of a special plastic surface which is acid and alkali resistant, and has a shiny surface.

Listing Chemicals in Short Supply

In several laboratories it is customary to check the whole of the contents of the store during the vacation or some other convenient time so as to list any chemicals which require re-ordering. When a large store is considered the time required is considerable. It also happens that sometimes certain chemicals are used rather more rapidly than usual, and this results in a sudden deficiency which may take some time to rectify. A system which can be advocated is to list all the chemicals and the respective number of bottles available in the store on a sheet of paper stuck on to a stiff back, such as hardboard. As each bottle is removed from the store it is immediately deducted from the list. Inspection of the sheet enables immediate check-up and saves time and effort, though of course it does not dispense with checks required by inventory.

There are other simple methods of tackling laboratory problems, but they can be more conveniently considered in separate articles.

(*To be continued*)

LOW-TEMPERATURE PRODUCTION OF OZONE

It has been found that oxygen is efficiently converted to ozone in a microwave discharge near a cold surface. This method for the laboratory production of ozone is capable of 100 per cent conversion under certain operating conditions.

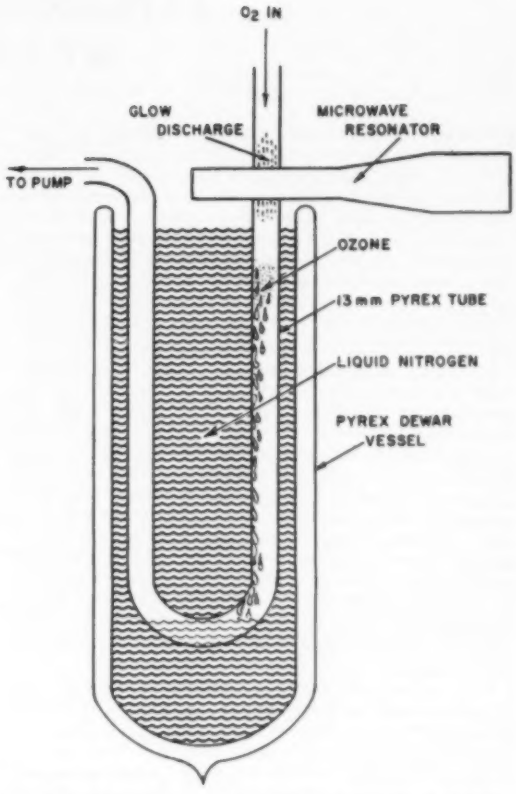


Fig. 1. Line-drawing of the experimental arrangement used by the National Bureau of Standards to develop a highly efficient method for the production of ozone.

A LABORATORY method for the efficient conversion of oxygen to ozone has resulted from National Bureau of Standards studies on trapped radicals, sponsored by the Department of Defence. The process, which gives nearly 100 per cent conversion under certain operating conditions, involves the electrical dissociation of oxygen in a microwave discharge near a surface cooled with liquid nitrogen. Not only is this a convenient method for producing ozone for laboratory use, but the possibility of commercially producing ozone in this way suggests that the expense which has to date limited its use can be considerably reduced.

Ozone (O_3) is an allotropic form of oxygen, having chemical properties similar to those of the usual form but more intense. For example, it is so strong an oxidizing agent that silver turns to silver oxide in its presence. This oxidizing effect makes ozone effective in purifying the air in public buildings, treating the water in municipal water supplies and swimming pools, and bleaching fabrics, starch, ivory, and certain oils. In addition to these uses, various commercial processes are directly dependent upon ozone, such as the manufacture of artificial camphor and vanilla extract. In its liquid form ozone sometimes explodes for unknown reasons and should therefore be produced in small amounts and handled by experienced personnel.

The Bureau's method for producing ozone resulted from studies of the low temperature reactions of atomic oxygen by guest workers in the free radical programme, R. A. Ruehrwein and J. W. Edwards of Monsanto Chemical Co. and J. S. Hashman of Callery Chemical Co. In this method, oxygen is sent through a high-frequency electric discharge into a Pyrex U-tube immersed in liquid nitrogen. The arrangement is such that a glow discharge occurs in the oxygen stream just above the liquid nitrogen level. Ozone is then produced as the dissociation products in this discharge condense on contact with the liquid-nitrogen-cooled surface. The liquid ozone, which forms in a narrow band on the wall of the U-tube a few millimetres below the glow discharge, drains slowly down the tube.

After unconverted oxygen is pumped off, the volume of the ozone yield at standard conditions of pressure and temperature can be calculated from the measured amount of liquid and its density. Comparing the yield with the volume of oxygen introduced into the system shows that 100 per cent conversion is possible under certain conditions.

The conversion efficiency for this arrangement depends upon flow rates, reaching its maximum at rates of 5·7 cc./min. and lower. At such low flow rates, all oxygen introduced into the system is converted so that pumping becomes unnecessary. However, much of the available energy is wasted at these rates, the energy efficiency being at its peak with much higher rates up to 360 cc./min. Above this limit, the 135 watts of microwave power available was not sufficient to maintain a stable glow discharge.

ULTRA-HIGH VACUUM

by P. A. Redhead

IN recent years, methods have been developed for producing pressures in the ultra-high vacuum range (below 10^{-9} mm. Hg.); these techniques have opened up a new field of experimental physics, in particular, surface physics. The pioneering work in ultra-high-vacuum was done by Alpert[1] and his group at the Westinghouse Research Laboratories. In the Radio and Electrical Engineering Division of the National Research Council of Canada, methods have been developed for obtaining and measuring pressures as low as 10^{-13} mm. Hg., and various studies of gas-solid interactions at low pressures are now being made.

Ultra-high-vacuum techniques are useful in three main fields: (*a*) the physics of surfaces and thin films; (*b*) the production of very pure gases, and (*c*) the simulation of extra-terrestrial conditions in the laboratory. Some idea of the importance of ultra-high vacuum to surface physics can be indicated by recalling that at a pressure of 10^{-6} mm. Hg. a clean surface will be covered with a monolayer of adsorbable gas in about one second. Thus to maintain a surface with a coverage of less than 1/10 monolayer for a period of one day, a pressure of less than 10^{-12} mm. Hg. of chemically active gases must be achieved. U-h-v techniques are thus of great value in the study of adsorption of gases on solids, emission from solids, and in any measurements of surface properties which are affected by the presence of an adsorbed layer of gas.

U-h-v techniques must be used whenever a gas is to be maintained with a high purity at reduced pressures. In particular, thermonuclear devices employing a discharge in deuterium or tritium require a very low level of contamination in the gas discharge. Considerable advances have been made recently in obtaining pressures in the u-h-v range in large thermonuclear devices of several thousand litres in volume.

Work on the simulation of extra-terrestrial conditions in the laboratory is very recent. It is worth noting that it is already possible to produce pressures in the laboratory of the same order as are predicted to exist at the surface of the moon.

One of the major problems in ultra-high vacuum technology is the measurement of these extremely low gas pressures. Alpert's group developed a new form of hot-cathode ionization gauge (the Bayard-Alpert gauge) which is capable of measuring pressures as low as 5×10^{-11} mm. Hg. This level represents an improvement of two to three orders of magnitude over the lowest pressures measurable with previous gauge designs. The lowest pressure measurable with the Bayard-Alpert gauge (as with all hot-cathode gauges) is established by the 'x-ray limit'. Soft x-rays are produced at the grid by electron bombardment, these x-rays then cause photo-emission from the ion-collecting electrode. The photo-current from the ion collector is independent of pressure and indistinguishable in the measuring circuit from the true positive ion current which is proportional to pressure. Thus at very low pressures where the positive ion current is smaller than the x-ray induced photo-current it is no longer possible to measure pressure.

A cold-cathode discharge gauge with magnetic field (Penning type discharge) has been developed at NRC[2] which has no x-ray limit and which is capable of measuring to at least 10^{-13} mm. Hg. This gauge, known as the 'inverted-magnetron gauge', has no x-ray limit because the electron current producing the x-rays is at all times proportional to pressure. The anode of the gauge is a rod placed on the axis of the system and surrounded by the ion-collector which is a closed-ended cylinder. The anode rod passes through holes in the end-plates of the ion-collector and the edges of these holes are shielded by the two auxiliary cathode discs which suppress field emission from the ion-collector. The gauge is operated at an anode voltage of 6 kilovolts and an axial magnetic field of 2,000 gauss.

This gauge has been calibrated from 10^{-3} to 10^{-13} mm. Hg., and the ion current follows the relationship

$$i_+(\text{ampts.}) = 1{\cdot}0p^{1{\cdot}1}\ (\text{mm. Hg.})$$

for nitrogen. The lowest measurable pressure is established by the noise level in the ion current amplifier, and is about 10^{-14} mm. Hg. in a practical system.

The inverted-magnetron gauge is a fast pump for the chemically active gases, and pumps the inert gases more slowly. These properties have permitted construction of extremely simple ultra-high vacuum systems 'getter-ion' pumped system which do not use diffusion pumps and thus avoid contamination from pump fluids. The system is rigorously baked while being pumped by the mechanical pumps; at the end of the bake the u-h-v valve is closed and a small quantity of titanium evaporated. The pressure in the system is reduced, by the gettering action of the titanium, to approximately 10^{-7} mm. Hg. in a fraction of a minute. The metal electrodes of the system are then outgassed and the gauges turned on. Within eight hours the pressure will equilibrate at about 5×10^{-11} mm. Hg. The evaporated film of titanium acts as an extremely fast pump to the chemically active gases while the ionization gauge pumps the noble gases. The residual gas in the system consists of about 90 per cent helium (caused by atmospheric helium diffusing through the glass envelope), 9 per cent hydrogen, 1 per cent carbon monoxide and a trace of argon. These getter-ion systems will maintain these low pressures indefinitely; they have been used for numerous experiments involving the continuous admission of gases where it is possible to pump moderate quantities of gas (of the order of a few litre-microns) and to achieve the original residual pressure once more when the gas source is removed.

Pressures below 5×10^{-11} mm. Hg. have been achieved[2] by immersing part of the system in liquid helium. The cold surface of the glass acts as a fast pump to all gases, including helium, provided that the coverage of the surface is less than a monolayer. Pressures of about 10^{-13} mm. Hg. have been obtained by this method.

The cold-cathode gauges developed at NRC are now being re-engineered to withstand the shock and vibration of a rocket, and it is planned to include three of these gauges in a satellite to be launched by the United States National Aeronautics and Space Agency in 1960.

REFERENCES

[1] Alpert, D. (1958). Handbuch der Physik, XII, 609.
[2] Redhead, P. A. (1958). Can. J. Phys., 36, 255.
Hobson, J. P. and Redhead, P.A. (1958). ibid. 271.

Laboratory Note-Book

STRIKING evidence of British industry's belief in the value of co-operative research is provided by British tanners. Two important trade federations—the United Tanners' Federation and the British Kid Tanners' Association, representing about two-thirds of the whole industry—have introduced a scheme to give additional support to the British Leather Manufacturers' Research Association, under which membership of the Research Association becomes a condition of belonging to either of the Federations.

It is hoped to extend this scheme to other trade associations in the industry. Meanwhile, it raises the proportion of support from about 60 per cent to over 75 per cent of the entire industry, increasing the industrial income of the BLMRA to £35,000 p.a.

The BLMRA was one of the first co-operative research associations to be formed. It has steadily expanded over the last 40 years to become increasingly valuable to the industry and now it is generally acknowledged to be the leading leather research organization in the world.

In the last few years, BLMRA has faced the dangers of reduced income—not because of dwindling support from the industry but mainly because the industry itself has been in difficulty. It is well known that the two largest sections of the leather trade are faced with acute competition; the sole leather tanners from synthetic soling materials and the chrome upper leather tanners from duty-free imports of Commonwealth origin. The closure of some members' tanneries has inevitably meant reduced industrial income for BLMRA with a corresponding loss of Government grant. Another factor contributing to the difficulties of BLMRA has been the impact of the DSIR policy of a progressive stiffening of the terms of grant by which industry is normally required to bear an increasing proportion of the cost of the research.

In spite of these difficulties the leather industry is convinced that it has an important future; it is also convinced that the BLMRA has a vital part to play. As a result, British tanners have taken far-reaching measures to put its research association on a sound financial footing, and the new 'comprehensive-membership' scheme which has been adopted by the United Tanners' Federation and the British Kid Tanners' Association will guarantee a more stable income. As from the beginning of this year, all members of these two federations, apart from certain nominal members, must also be members of the Research Association. In return, the Research Association has introduced reduced subscription rates for these federation or comprehensive members.

This new scheme will clearly be of immense value in widening support for BLMRA and ensuring that it can continue to give good service to the industry. In this it can render great assistance by improving the competitive position of leather, especially by consolidating the advantages of leather over synthetics, by cutting production costs without loss in quality and by introducing technical improvements. New qualities in wear, waterproofness, texture and colour are constantly demanded—and provided by the industry and the Research Association together. The answer may be given immediately; it may require short or elaborate tests, or a process survey in the tanner's own works, it may be found among over a thousand books on the R.A.'s library shelves; but manufacturer and scientist work together. Last year, nearly 800 problems were submitted by members and 157 visits were made by staff to member firms.

In the export market, British leather ranks high. It is important, therefore, to maintain and improve the properties and qualities of leather. Continental customers may soon insist on the use of the new international method of test for the assessment of the physical properties of leather—methods requiring new and very costly apparatus. This equipment is already on order and when it is installed the BLMRA will be able to render exceptionally valuable service to the industry.

BLMRA enters the new decade in good heart, it can, and will, give good value to all who support it.

Wolfson Research Professorship

The Council of the Royal Society has accepted with warmest thanks the offer of the Isaac Wolfson Foundation to create a special fund of £200,000 for the endowment of a Research Professorship, to be known as the Wolfson Research Professorship of the Royal Society.

The Chair is to be held by a distinguished British scientist who will devote the whole of his time to research in such fields as the President and Council of the Royal Society may from time to time think appropriate. The first holder, who has yet to be appointed, will work in the physical sciences or their borderlines with biology.

The financial provision allows for adequate scientific and technical assistance for the Wolfson Research Professor.

This generous grant is a notable addition to the resources at the disposal of the Royal Society for the encouragement of original scientific work and is an instance of imaginative foresight on behalf of the Isaac Wolfson Foundation. It marks, with great promise for the future, the opening of the Society's Tercentenary year.

A Notable Century

Reliable information about careers in various skilled trades and in the professions is essential to young people about to leave school if they are to make a wise choice of job.

One method by which this has been achieved, the 'Choice of Careers' series of booklets, prepared by the Central Youth Employment Executive, reached a notable landmark on April 4, 1960, with the issue of its 100th title 'The Scientist' (H.M.S.O., price 1s. 3d. net).

Being issued at the same time are two other new booklets, 'Laboratory Technicians and Assistants' (price 2s. 6d.) dealing with the subject closely allied to scientists, and 'Choosing your Career' (price 1s. 6d.) an introductory booklet to the whole series, dealing with the basic questions which young people need to sort out in selecting the particular occupation in which they intend to make their career.

'The Choice of Careers' series was started 12 years ago, with the aim of giving school leavers some indication of the opportunities offered by various occupations. Since its inception there have been 163 editions, many of them revisions of earlier issues, bringing up to date the information they contained in the light of later developments in the profession, trade or industry; others deal with new subjects to meet the numerous requests made to widen the scope of the booklets.

Total sales of all editions so far are well over a million. Six editions published during the past two years have had to be reprinted within a year of publication.

Booklets in this series describe the main features and practices of a profession, industry, craft or service. They also provide information about methods of recruitment, or entry, the training involved, the prospects for promotion, conditions of employment, facilities for further education, and the opportunities provided by other allied trades in particular industries. The majority contain photographs of actual processes or operations illustrating occupations dealt with in the text.

Many of the earlier booklets dealt with traditional crafts with recognized training schemes. As the booklets have become more widely known to schools and the public, the series has been extended and now covers a wide variety of occupations.

The importance of the role of science is reflected in the publication of the two latest booklets. Further related subjects which are projected are 'Mathematics', which has just been started, and 'Applied Science and Technology' which will follow.

'The Scientist,' which is illustrated, is written mainly for those science students who aim at obtaining a good degree by full time university courses, or who will

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News from the British Association of Chemists

Exhibition of Scientific Apparatus

The Liverpool Section of the B.A.C. held its Annual Exhibition this year in the Donnan Laboratories of Chemistry at the University of Liverpool on April 6 and 7, 1960. This is the fourteenth year in which the Exhibition has been held and it was opened by Prof. C. E. H. Bawn, C.B.E., F.R.S., Head of the Department of Inorganic and Physical Chemistry, The University of Liverpool. Prof. Bawn also arranged to open some of his research laboratories during the two days of the Exhibition, so that visitors might see the large range of modern equipment which they contain.

The list of exhibits was as follows: **Research & Control Instruments Ltd.**, Spectrographic apparatus; **Sheen Instruments (Sales) Ltd.**, Glossmeters, viscometers, film applicators, etc.; **Silverson Machines (Sales) Ltd.**, Mixing and emulsifying equipment; **The Solartron Electronic Group**, Electronic instruments; **Southern Instruments Ltd.**, Polarographs and photometers; **Stanton Instruments Ltd.**, All types of analytical balances; **Technicon Instruments Co. Ltd.**, Technicon auto-analyzer and accessories; **The Thermal Syndicate Ltd.**, Vitreosil laboratory ware, etc.; **H. Tinsley & Co. Ltd.**, The Quére titrator, chromatographic detectors, etc.; **The Tintometer Ltd.**, Instruments for colour measurement and colorimetric analysis; **J. W. Towers & Co. Ltd.**, A very large range of scientific apparatus and equipment; **Townson & Mercer Ltd.**, Vacuum moisture tester and other recent additions to the T. & M. range; **W. E. Tuck & Co. Ltd.**, Laboratory furniture; **J. W. Turner & Son**, A general range of laboratory apparatus; **Baird & Tatlock (London) Ltd.**, General and specialized laboratory apparatus; **Donald Brown (Brownall) Ltd.**, Laboratory bench fittings; **Electronic Instruments Ltd.**, pH meters and other electrical equipment; **H. J. Elliott Ltd.**, E-MIL range of laboratory apparatus; **Elliotts (Liverpool) Ltd.**, Pathological laboratory apparatus; **Hudes Merchandising Corporation Ltd.**, Micro and sedimentation balances, centrifuges, etc.; **Jencons (Scientific) Ltd.**, Silica apparatus, microdiffusion pumps, etc.; **Kek Ltd.**, Laboratory grinding apparatus, etc.; **Kodak Ltd.**, Eastman organic research chemicals, biochemicals, etc.; **Laboratory Apparatus & Glassblowing Co. Ltd.**, Laboratory apparatus in stainless steel, plastics and glass; **A. M. Lock & Co. Ltd.**, pH, photo-electric, and other specialized equipment; **McMurray Industries Ltd.**, Micro-combustion furnaces and apparatus; **Nash & Thompson Ltd.**, Polarographic apparatus and metallurgical equipment; **Optica United Kingdom Ltd.**, Spectrophotometers, densitometers, etc.; **L. Oertling Ltd.**, All types of analytical balances; **A. E. Parry & Co.**, Scientific books, technical literature, etc.; **Perkin-Elmer (Sales) Ltd.**, Spectrophotometers and apparatus for gas chromatography; **The Permutit Co. Ltd.**, Ion exchange resins and equipment; **Premier Colloid Mills Ltd.**, Mills and mixers for laboratory use; **W. G. Pye & Co. Ltd.**, Pye argon chromatograph, pH and other electrical equipment; **Quickfit & Quartz Ltd.**, Nitrogen determination apparatus and extraction equipment.

Fédération Internationale des Cadres de la Chimie et des Industries Annexes

As readers of this page will recall it was hoped to arrange a public meeting to enable representatives of the professional associations in Great Britain to meet representatives of F.I.C.C.I.A. and also of the Confédération Internationale des Cadres (C.I.C.) and to hear from them of the work which they are doing in connection with the protection of the economic interests of professional men. This meeting was held on May 6, 1960 at the Charing Cross Hotel. M. André Malterre, who is the Secretary-General of C.I.C., made a special journey to London for the purpose of attending this meeting.

Short papers were read by:

1. Dr. A. Ferrero (Switzerland—President of F.I.C.C.I.A. and permanent representative of the C.I.C. at the I.L.O. at Geneva) on the work of F.I.C.C.I.A., C.I.C. and the I.L.O.
2. Dr. F. W. Guthke (W. Germany—Vice-President of F.I.C.C.I.A.) on the 'Rewards of Salaried Inventors' and 'Pensions for Senior Employees'.
3. M. Jean Caillaud (France—Secretary of F.I.C.C.I.A.) on Restraint Clauses in Service Agreements and on Collective Agreements.

On the evening of Saturday, May 7, the B.A.C. entertained the F.I.C.C.I.A. delegates and their wives at a Dinner, and on Sunday, May 8, the party were taken for a drive to see some of the beauty spots within easy reach of London.

News from the Sections

London

The Section held a Film Show at the Wellcome Institute on March 16, 1960. The programme selected was intended to be of special interest to the younger members and the films shown were as follows:

Proud Ships
Isle of Man T.T.
Distillation
Vacuum Distillation.

On February 17, 1960, Dr. Abelmann, of Scientific Chemicals Ltd. ('Innoxa'), lectured to members of the Section on Cosmetics. Dr. Abelmann introduced his lecture by explaining the structure of the human skin and the effects of the sebaceous and sweat glands. The subject was treated from a strictly scientific point of view and was well received by the audience.

All correspondence and enquiries concerning this Association should be addressed to G. R. Langdale, Esq., The British Association of Chemists, Nomination Dept., 14 Harley Street, London, W.1. Tel.: Museum 7021.

Obituary

The decease of the following members is recorded with regret:

H. L. Maxfield. Elected M. 1919. London. Aged 65.

C. J. Ridout. Elected M. 1919. Birmingham. Aged 72.

E. P. Westlake. Elected M. 1925. London. Aged 65.

Laboratory Note-Book.

(*Concluded from page* 329)

study for an external degree or diploma in technology or equivalent qualifications either by full time courses or sandwich courses. An outline of such courses is included in the booklet. No attempt is made to cover every branch of science, but most attention is given to the basic sciences, physics, chemistry and biology, in which the great majority of scientists begin their careers. The different capacities in which scientists are employed, and a guide to the main organizations and Government departments employing scientists, which are dealt with in the booklet, may be of particular help to students seeking a career in science.

'Laboratory Technicians and Assistants' deals with the opportunities available for young people as helpers in the work scientists are doing in industry, agriculture, public health and many other spheres. It gives an outline of the different kinds of laboratories, and the functions and duties of laboratory technicians, and illustrates their day-to-day work from actual examples drawn from testing, research and plant control work in industrial university and Government laboratories.

'Choosing a Career' sets out some of the basic questions involved in the problem of making a choice of a career. There are sections about different types of work, whether in offices, with people, out of doors, technical, professional or artistic, about the levels of entry, methods of training and what different types of job have to offer.

LABORATORY EQUIPMENT & APPLIANCES

Computer for Evaluation of Emission Spectrograms

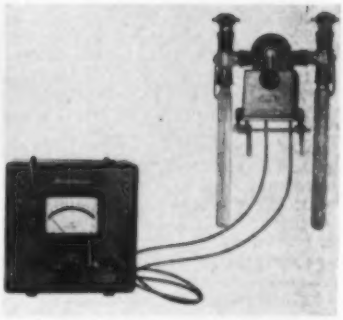
A complete evaluating device, known as the *Török-Baják* system, made by Meovill, Budapest, comprises an electric computer of an analogue system, operating partly automatically and built especially for the purpose of spectrochemical analysis. The device is composed of combinations of analogue circuits. The quantities occurring in mathematical operations are reproduced as voltage or ohmic resistance values equal to them numerically. The transmission of these values from the one circuit to another is carried out by compensation. This compensation is performed by automatic servo-mechanisms in the most frequently occurring cases in order to accelerate the working and make it more reliable. For example, automatic memory units fix the intermediate values as long as they are necessary during the further computations. A particular property of the device is that the parameters needed for setting in to single analysis problems present themselves as average values of a number of measurements by means of one unit automatically operated.

For the complete evaluation, depending on the analysis, the setting of from four to six constants is necessary. Three or four of these are values known beforehand from tables and thus they can be set in advance on the appropriate scale. The remaining one or two constants are produced automatically from the current measurement.

The evaluation of an analysis series is carried out by means of the constants in such a manner that single measurement results are set in successive logical sequence on the scale S on the right upper side of the apparatus and the final result is read from the automatically operating $c/\triangle Y$ scale.

The most complicated evaluation can also be carried out at the same time as the densitometry of the spectral lines. The operator of the photometer dictates the measurement results successively to the operator handling the evaluation device who sets them in order on the scale S of the device and switches forward the adequate operation switch to the next range and records the final result after each series. For an analysis series consisting of 100 components an economy of from one to six working hours is attainable compared with the old methods of the evaluation, depending on the complexity of the test. By means of the new device the complete evaluation of the above mentioned series can be made in from 15 to 30 minutes, and this is accomplished simultaneously with the photometry. Nevertheless, this method of evaluation does not require more detailed attention, and thus it is not fatiguing and contains less possibility of error than the old method. The capacity of the device is large enough to permit the evaluation of the spectrogram series made by a laboratory using more than one spectrograph. The introduction of the new method is especially valuable for routine analyses in manufacture where speed, the saving of manpower and the elimination of error secure important economic advantages.
(Representatives in England for Metrimpex, Budapest: C. R. Braybrooke & Co., Ltd., Dashwood House, Old Broad Street, London, E. C. 2.).

The Gammagraph has been developed to measure continuously the fall-out of gamma radiation indoors or out-of-doors, such as in the vicinity of a nuclear power station. Powered by an ordinary car battery and completely weatherproof, it can work in isolated country places continuously for one month without any attention. This instrument for keeping a check on nuclear radiation has been designed by Electronic Instruments Ltd., of Richmond, Surrey.



Electronic micro vacuum balance.

Electronic Micro Vacuum Balance

The latest Sartorius-Werke instrument is an electronic micro vacuum balance called the Electrono. This works on the basis of compensating forces and can be used with a recorder for continuous recording of weight changes, from 1 microgram up to 1 gram.

The Electrono vacuum permits work in the following fields: Oxidation measurements, dry oil and metals under various conditions, evaporation of metals, thermo-gravimetric analysis, differential thermal analyses, control measurement of purity and imperviousness of electrolytic coatings of refined metals, high temperature weighings, study of absorption and adsorption, observation of diffusion processes, surface tension, electrostatic force, and magnetic susceptibility, investigation of catalysts and luminous materials.

Determinations of specific surface of powders are usually by the gas volumetric method, giving a determination down to 5 sq. metre per gram. Now the Electrono vacuum makes it possible without loss of accuracy, to determine the specific samples in the range 0·3 sq. metre per gram.
(U.K. Agents: Hudes Merchandising Corporation Limited, 52 Gloucester Place, London, W.1.

New Automatic Electric Instrument Sterilizers

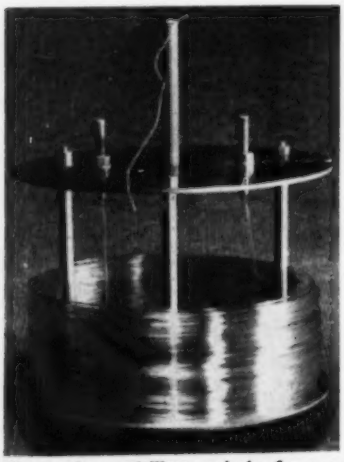
A new range of portable instrument sterilizers incorporates thermostatic control, a feature previously confined to larger units. One advantage of this control is that although a high load is employed to reduce the preheating time to a minimum, the thermostat operating in a vapour tube ensures that only sufficient current (as little as 15 per cent of the full load) is used to maintain temperature once boiling point has been reached. Another advantage is that no excess steam is produced to damage surroundings. Since little evaporation takes place, the sterilizer may safely be left unattended throughout long periods of sterilization.

The opening mechanism consists of a single action lever which opens the lid and lifts the instrument tray in one operation. At the same time it locks them in the open position. A draw off tap is fitted at the front of each sterilizer.

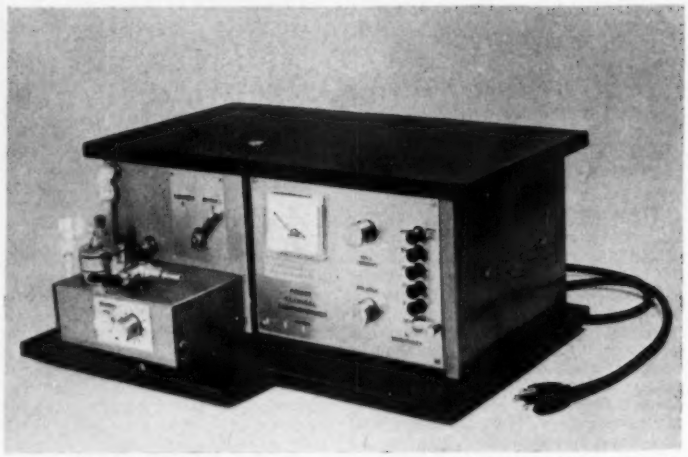
The bodies are constructed of heavy gauge copper with the interiors dull nickel plated and exteriors chromium plated. Each unit is fitted with a sheathed wire immersion heater, incorporating a water low-level cut-out with reset button. A protective perforated copper shield is fitted over the element.

Fittings provided with each unit include a perforated copper instrument tray, a pair of steel lifters and 3 ft. of white plastic cable.

The four units in the range are: (*a*) The HO5480 with a 1½ kW. loading, a sterilizing space of 11 in. × 5½ in. × 4 in. deep, an approximate boiling time of 28 minutes, and a price of £35. (*b*) The HO5401 with a 2 kW. loading, a sterilizing space of 14 in. × 6½ in. × 5 in. deep, and approximate boiling time of 30 minutes, and a price of £40. (*c*) The HO5402 with a 3 kW. loading, a sterilizing space of 17 in. × 8 in. × 6 in. deep, an approximate boiling time of 30 minutes and a price of £52. (*d*) The HO5403 with a 4 kW. loading, a sterilizing space of 20 in. × 10 in. × 7 in. deep, an approximate boiling time of 40 minutes and a price of £72.
(Manufacturers: The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.)



These glass capillary spirals for gas chromatography, manufactured by A. D. Wood of 4-5 Skinner Street, London, E.C.1, have a bore of 0·008 to 0·010 in. and are available in lengths of up to 500 ft. These spirals are very promising, especially at high temperatures, i.e. 300° to 400° C., and in conjunction with the new ionization detectors, results have been obtained very speedily and with greater efficiency—the number of theoretical plates is around 1,000 per ft.



Clinical gas partitioner.

Gas Chromatography for Medical Gas Analysis

This new instrument employs gas chromatography for the first time in medical gas analysis. It enables a complete recorded analysis to be produced in six minutes, and requires only very small samples. This compares with the 20 minutes and much larger samples required for a determination by the Van Slyke method.

The instrument, known as the clinical gas partitioner and made by the Fisher Scientific Company of America, will provide qualitative and quantitative analyses of oxygen, nitrogen and carbon dioxide in whole blood, and in respiratory gases; and of the carbon dioxide content of blood serum. In eight minutes it will also determine the carbon monoxide content of blood.

As against the 1 ml. sample required for determination by the Van Slyke method, the clinical gas partitioner needs a sample of only 0·1 ml. of whole blood—and results are of comparable accuracy. This is an obvious advantage when working with children or small animals. For determining respiratory gases, a 1 ml. sample is generally used.

No pre-treatment of the samples is necessary and the analysis is entirely automatic. The instrument may be linked up to any standard 1 mV. recorder, and only simple calculations are necessary to determine volume percentages or Van Slyke values from the resultant chromatogram which, of course, becomes a permanent record.

The reproducibility of the clinical gas partitioner is such that most operators can reproduce analyses of whole blood or serum to ± 1·5 per cent, the figure being to some extent dependent upon the operator's technique of taking and injecting samples. A special gas sample valve, available as an accessory, ensures a reproducibility of ± 0·2 per cent for respiratory gas analyses.

The sensitivity is dependent on the size of the sample and the sensitivity of the recorder. Using a 0·1 ml. sample and a 1 mV. recorder, oxygen in whole blood can be determined down to 2 per cent by volume, and carbon dioxide down to 10 per cent by volume. With a 1 ml. sample these figures are improved to 0·2 per cent and 1 per cent respectively.

A push-button sensitivity control on the partitioner gives a choice of five recorder sensitivity levels, enabling the chromatogram peaks to be brought within readable range however small or large the component gases of the sample may be.
(Authorized distributors: Shandon Scientific Co., Ltd., 6 Cromwell Place, London, S.W.7.)

Jaytec Graduated Glassware

An entirely new brand of scientific graduated laboratory glassware is now obtainable under the trade name of JayTec. This glassware has been devised to meet the growing need of an economical range of graduated glassware manufactured specially for the commercial/technical user who requires a high class product of functional design for general laboratory use at an economic and low cost.

In order to familiarize the user with this new range of JayTec brand laboratory glassware a sample box containing a 100 ml. measuring cylinder, 50 ml. flask, 1 ml. measuring pipette, 10 ml. measuring pipette and a 10 ml. bulb pipette is now available from laboratory furnishers for the sum of 16s. 9d.

An informative leaflet and price list can be obtained from the manufacturers who will be pleased to arrange for any requirements to be satisfactorily and promptly dealt with.
(Manufacturers: F. R. Jones Ltd., 24 Gaskin Street, London, N.1.)

NEWS

Manufacturers' News

Demonstration Tour

During the present time, Cinematograph Export Ltd., Associate Company of W. Vinten Ltd., will be carrying out a sales and demonstration tour which will include visits to Government departments and aircraft manufacturers in France, Italy, Austria, Switzerland and Germany, in order to introduce their latest products.

The demonstration van will be carrying with it a comprehensive selection of equipment, so that examples of various types of cameras and photographic equipment for industrial research and aircraft use can be shown.

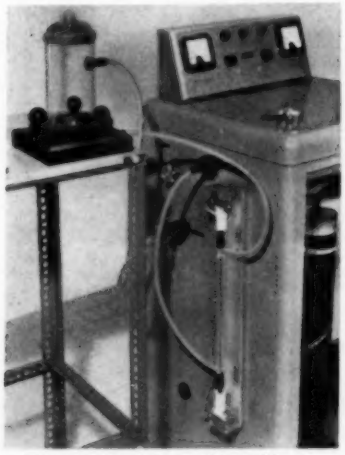
The interior of Vinten's demonstration van.

Technicon Instruments at Liverpool Exhibition

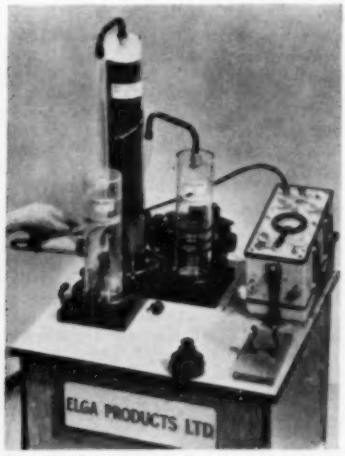
A laboratory model of the Technicon Auto-Analyzer was shown by Technicon Instruments Co. Ltd. at the Exhibition of Scientific Apparatus, Donnan Laboratories of Chemistry, University of Liverpool on April 6 and 7. This is claimed to be the world's first and only continuous wet chemistry analyzer, a robot chemist continuously performing everything that a chemist does in making a chemical analysis.

Elga Press Conference

Some of the latest developments in deionization techniques were described at a recent Press Conference held by Elga Products Ltd., at Grosvenor House, London, W.1. Among these were the Elgastat transistor washing with u.v. radiator which produces intrinsic water (i.e. water of almost theoretical purity) for transistor washing. The unit not only removes all dissolved ions, but also bacteria, viruses and undissolved solids. The u.v. radiation unit, inserted between the deionization column and the effluent point, serves as an additional sterilant. Another example was the Elgastat for the removal of radioactivity from water. Contaminated water enters column 2, then passes through the mixed bed ion exchange column. The purified water is collected in column 1. The presence of radioactivity is shown on the radiation counter; contact is made with a surface probe. In the photograph, the counter registers zero, indicating complete decontamination.



Elgastat transistor washing with u.v. radiator.



Elgastat for removal of radioactivity from water.

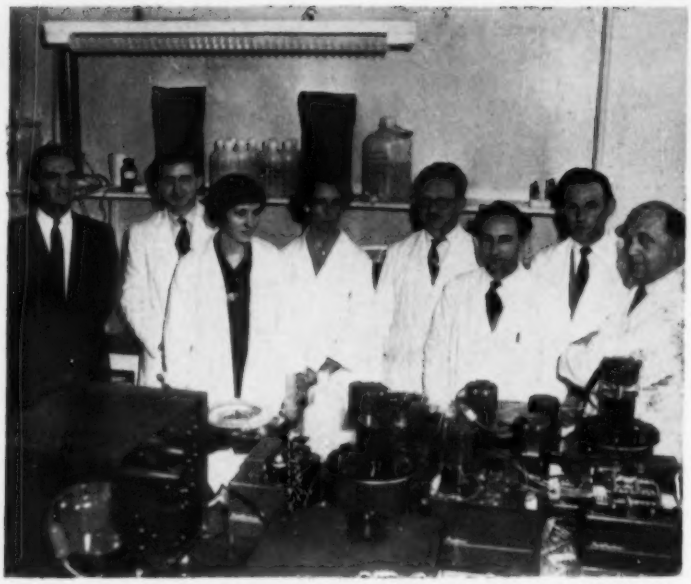
New Director of Research for Griffin & George

Mr. K. G. Sinclair, Chairman of Griffin & George, Ltd., Ealing Road, Alperton, Middlesex, and its subsidiary companies, including Griffin & George (Research & Development) Ltd., announces that Dr. A. J. P. Martin has expressed the desire to concentrate in future primarily on fundamental research work, and, therefore, wishes to retire as a Director of the Company. He has regretfully acceded to his request so that his eminent abilities (which, in the New Year's Honours List, have been given official recognition by his appointment as C.B.E.) may be used to their best advantage. Dr. Martin will continue to be retained by the Company in the capacity of Consultant and is succeeded, as Director of Research, by Mr. R. C. Palmer, M.A. (Cantab.), his present deputy.

Equipment for New College Laboratories

A contract, valued £10,000, has been secured against tender by Griffin & George, Ltd., to supply the scientific equipment for the laboratories of the new Mid-Hertfordshire College of Further Education at Welwyn Garden City, Herts.

The order includes the complete scientific equipment for the College, with the exception of certain very specialized pieces of equipment.



Chemists and biochemists from various parts of the U.K. are shown attending the third Instruction Course in the use of the Technicon AutoAnalyzer which started on March 21. Every organization purchasing an AutoAnalyzer is invited to send a qualified chemist to these Courses of Instruction which are held regularly in the London laboratories of Technicon Instruments Co., Ltd.

Anticoagulant Control

Evans Medical Ltd., have been appointed by Nyegaard & Co. A/S of Oslo to be distributors of Thrombotest (Owren), and stocks of this product are now available.

Thrombotest (Owren) is a new reagent for the determination of coagulability of the blood in the control of anticoagulant therapy. The product is presented in a lyophilized form and makes possible a combined estimation of all four coagulation factors which are known to be reduced by treatment with oral anticoagulants.

The product is available as small and large packs each containing five ampoules. Depending on the amount of material used for each test the small pack contains sufficient material for 20 to 40 tests and the large pack sufficient for 100 to 200 tests.

Prices to hospitals: small pack 45s. large pack 150s.

The product is not subject to Purchase Tax.

Personal Notes

Dr. M. E. Haine

Dr. M. E. Haine, D.Sc., M.I.E.E., F.Inst.P., has been appointed Director of A.E.I. Harlow Research Laboratory. He succeeds Dr. G. W. Sutton, B.Sc., Ph.D.(Eng.) M.I.E.E., who has retired, but who is continuing in a consultative capacity until May.

Harlow, and its associated Blackheath Research Laboratory, serve four A.E.I. Product Divisions that are managed by Associated Electrical Industries (Woolwich) Ltd. (formerly Siemens Edison Swan Ltd.). They are A.E.I. Cable Division, A.E.I. Construction (Cables and Lines) Division, A.E.I. Radio and Electronic Components Division, and A.E.I. Telecommunications Division.

Dr. Haine was formerly Manager of the Harlow Research Laboratories. After taking an electrical engineering degree at Bristol University in 1936 he served a two year college apprenticeship with the Metropolitan-Vickers Electrical Co., of Manchester, spending three months of this period at the television laboratories of the Edison Swan Electric Co. at Brimsdown, Middx.

A period in the High Voltage Laboratory of the Metropolitan-Vickers Research Department was followed by a transfer in 1939 to the Radio Laboratory where he worked on the early radar chain transmitter project. He returned to the High-Voltage Laboratory in 1941, and was jointly responsible for the development of a new type of pressurized triggered spark gap device, the Trigatron, used to generate short modulation pulses for magnetrons used in radar transmitters. Towards the end of the war, he took up development and research work on the electron microscope.

In 1945 Dr. Haine spent several months in the United States, working on the atomic bomb project.

In 1947, he became responsible for the Electron Physics Section of A.E.I. Research Laboratory, at Aldermaston, where research on electron optics, the electron microscope, electron guns and high vacuum phenomena was carried out. He became Consultant to the Siemens Edison Swan Research Laboratory at Harlow in 1956.

Catalogues, Brochures & Leaflets
Received from Manufacturers

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd., of Poole, Dorset, are listed in the March, 1960 issue of their monthly leaflet. These are as follows: *Organic and Inorganic Chemicals.*—Bromo-pyrogallol red; 3-chloro-2-methyl-1-propene; methanesulphonyl chloride; pyrogallol red.

News and Review.—The first issue of a bi-annual Gallenkamp-Towers publication, titled *News and Review*, has been sent to us by A. Gallenkamp & Co., Ltd. of Sun Street, London, E.C.2. Its object is to draw attention to new items of apparatus and equipment, to further the personal contact between instrument maker and instrument user, to pay tribute to those universities, research and industrial laboratories proffering information on the changing methods and new techniques which are constantly being developed, to disseminate news about policy changes and to produce a readable reference to the company's current affairs.

Laboratory Equipment.—In *Laboratory Practice*, 9, 124, an item was published concerning A. D. Wood of 4-5 Skinner Street, London, E.C.1, which they wish to correct. They have not, in fact, 'just published a new 1960 range of stopcocks' but a new price list. Prices of graduated glassware are altered but no others, the main object being to consolidate and bring up to date the 1959 lists. The company have not just added Quickfit & Quartz apparatus to their list, as they have been a main agent for this for over 10 years, and Edwards High Vacuum equipment has been supplied off the shelf for over two years. They have increased their range by adding E-Mil apparatus and the Pyrex range to their service. The company's full range now comprises the following: Quickfit & Quartz apparatus; Edwards High Vacuum equipment; graduated glassware; laboratory appliances and scaffolding; rubber ware; plastic ware; E-Mil apparatus; the Pyrex range; coiled glass capillary spiral, and their own range of high vacuum glass stopcocks.

Refrigeration Dryers.—*Dry Pneumatics*, publication No. 709, published by AEI-Birlec Ltd., Tyburn Road, Erdington, Birmingham 24, includes details of an entirely new range of Birlec refrigeration dryers for compressed air applications.

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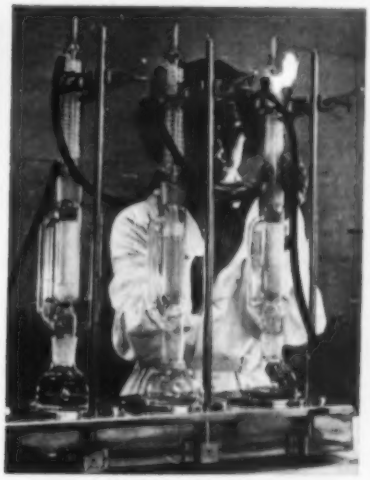

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Publications

Tin Research in 1959

The Annual Report of the International Tin Research Council mentions several new lines of investigation in metallurgy, tinplate, electrodeposition, and in organotin chemistry.

In the metallurgical field, systematic investigations are continuing into the alloys of tin with the newer metals titanium, zirconium and niobium. The effects of tin in cast iron and in steels are being further studied and practical trials are being made with cast irons containing prescribed additions of tin.

Bright deposits of tin can be made by electrodeposition using wood tar additions in the plating vat. The Institute is trying to discover which constituents of the tars are effective so that the process can be simplified.

Several new studies of the properties of tinplate are mentioned. A new method of assessing porosity of tin coatings by measurement of flow of current is described.

Forthcoming Scientific and Technical Conferences

An addendum to List No. 26 of Forthcoming International Scientific and Technical Conferences has been published by the Department of Scientific and Industrial Research, Overseas Liaison Group, Africa House, Kingsway, London, W.C.2.

Revision of Regulations

The Regulations for admission to the classes of Graduate and Associate Membership of the Institution of Chemical Engineers have recently been revised in part.

The revisions are mainly concerned with the definition of qualifications which exempt completely or in part from The Institute Examination. The new basis for complete exemption from The Institution Examination is the satisfactory completion of an honours degree course for a first degree in chemical engineering of a British University. The application of this principle is shown in the revisions to Appendix II of the Regulations. Many who were previously required to take Part 3 (The Design Problem) or Part 4 (The Oral Examination) for promotion to Associate Membership are now exempt from the whole Examination, but will, of course, have to comply with the other requirements for such promotion.

In addition, the new edition of the Regulations incorporates the revised syllabus for the Engineering Drawing Examination, Paper D, which comes into force with the 1960 Examination.

Directory for School Leavers

The number of insurance companies giving their recruitment requirements in the 1960 Directory of Opportunities for School Leavers (Cornmarket Press Ltd., price 8s. 6d.) is nearly double the number listed in 1959. The total number of entries in the Directory has increased by nearly 25 per cent from 134 to 165, and of these 19 are insurance companies. Other increases are under the headings of business machine manufacturers, building and contracting and civil engineering, motor car manufacturers, research establishments, and banks.

Thirty thousand copies of the Directory have been sent free of charge to schools which educate boys and girls up to school-leaving age. Youth employment officers, careers advisory officers, and the Public Schools Appointments Bureau will all receive complimentary copies.

The editorial section is both valuable to the school leaver and easy to read. *Going to University* provides for the mystified would-be undergraduate, and for his parents, a concise guide through the intricacies of university entrance requirements. Fielden Hughes, well-known children's writer and broadcaster, also a headmaster, advises school leavers on how to assess themselves for a suitable career. The professions are covered in an authoritative article; *Technical Training and Apprenticeship* are both dealt with and there is an article on the *Opportunities for Girls in Industry*.

The reference section sets out in detail information about commercial and industrial organizations and government departments. The classified index summarizes in tabular form further information about the size of the organizations, whether boys or girls are employed, and the areas in which employment is offered.

MEETINGS FOR THE MONTH

Mid-May to Mid-June

We give below a selection of meetings of interest to laboratory workers. Details are as full as possible at the time of going to press, but readers requiring further information or confirmation of arrangements should contact the organizers.

May 9

The Chemical Society (Durham Section). In the Science Laboratories, South Road, Durham. 5 p.m. 'Electrode Processes Involving Transition Ions', by Mr. N. S. Hush, M.Sc., Joint Meeting with the Durham Colleges Chemical Society.

May 12

The Society for Analytical Chemistry (Midlands Section). At the Gas Showrooms, Nottingham. 7 p.m. Meeting on 'Applications of Gas-Liquid Chromatography to the Analysis of Essential Oils', by D. Holness.

May 13

The Society for Analytical Chemistry (North of England Section). At Hull. Joint Meeting with the Microchemistry Group of the Society on 'Corrosion'.

May 17

The Chemical Society (Irish Republic Section). In the University Chemical Laboratory, Trinity College, Dublin. Centenary Lecture, 'Chemical Constitution and Immunological Specificity', by Prof. M. Heidelberger.

May 19

The Chemical Society (Manchester Section). In the Large Lecture Theatre, Chemistry Dept., The University, Manchester. 6.30 p.m. Centenary Lecture, 'Chemical Constitution and Immunological Specificity', by Prof. M Heidelberger.

May 20

The Society for Analytical Chemistry (Western Section). In the Conference Room, Municipal Building, Poole. 6.30 p.m. Joint Meeting with the Physical Methods Group of the Society on 'Atomic Absorption Spectroscopy'.

May 23

The Chemical Society (Newcastle upon Tyne Section). In the Chemistry Dept., King's College, Newcastle. 5.30 p.m. Centenary Lecture, 'Chemical Constitution and Immunological Specificity', by Prof. M. Heidelberger.

May 25

The Chemical Society (Hull Section). In the Physics Lecture Theatre, The University, Hull. 5.30 p.m. Official Meeting and Centenary Lecture, 'Chemical Constitution and Immunological Specificity', by Prof. M. Heidelberger.

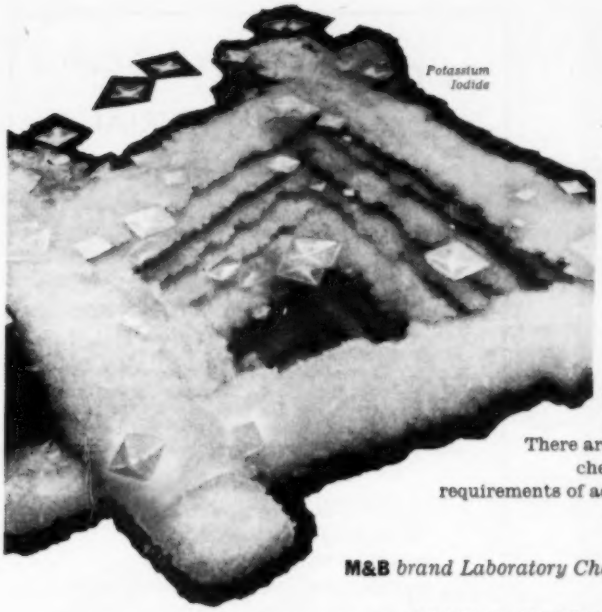
May 27

The Society for Analytical Chemistry (Western Section). At Plymouth. Joint Meeting with the South Western Section of the R.I.C. on 'Trace Elements in Sea Water', by L. H. N. Cooper, PH.D., D.SC., F.R.I.C.

The Chemical Society (Cambridge Section). In the University Chemical Laboratory, Lensfield Road, Cambridge. 5 p.m. Centenary Lecture, 'Chemical Constitution and Immunological Specificity', by Prof. M. Heidelberger.

June 2

The Chemical Society (London Section). In the Rooms of the Society, Burlington House, London, W.1. 7.30 p.m. Centenary Lecture, 'Chemical Constitution and Immunological Specificity', by Prof. M. Heidelberger.



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Interesting Facets

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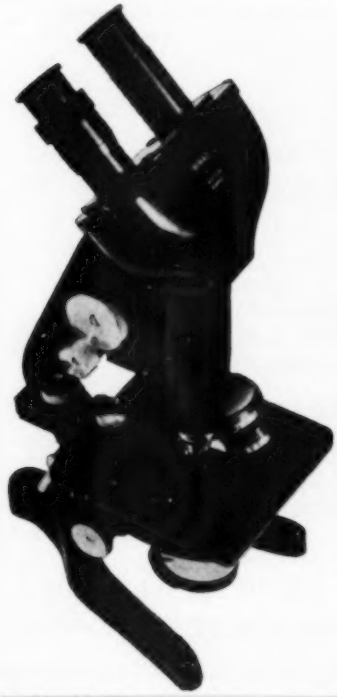

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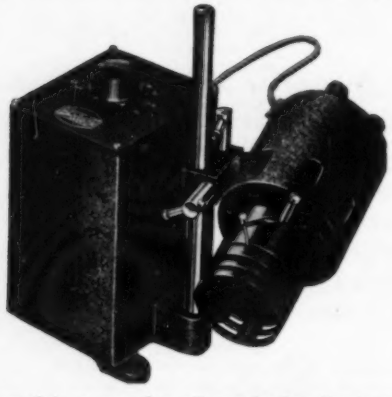

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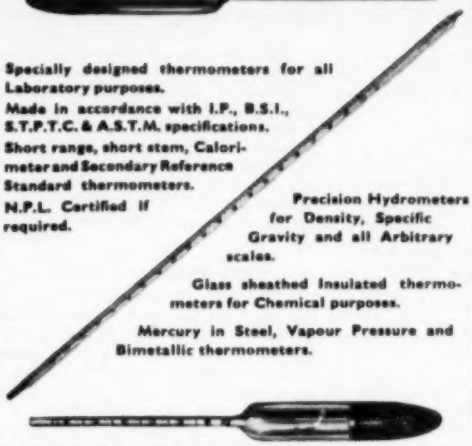

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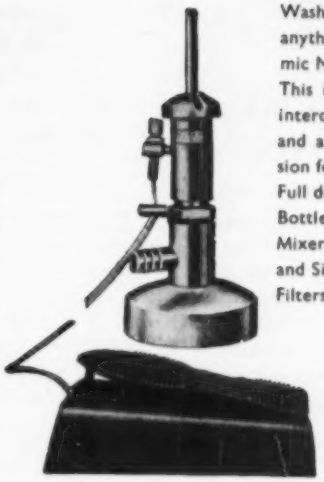

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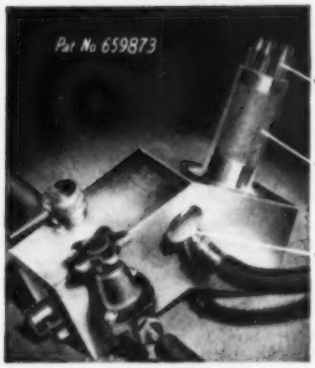

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